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GEOLOGICAL SURVEY OF CANADA.
ALFRED R. C. SELWYN, F.R.S., F.G.S., DIRECTOR.

# MESOZOIC FOSSILS.

## VOLUME I.

PART I.—ON SOME INVERTEBRATES FROM THE COAL-BEARING ROCKS OF THE QUEEN CHARLOTTE ISLANDS, COLLECTED BY MR. JAMES RICHARDSON IN 1872.

BY J. F. WHITEAVES, F.G.S.,
HONORARY MEMBER OF THE ASHMOLEAN SOCIETY, OXFORD.

MONTREAL:
PRINTED FOR THE GOVERNMENT OF CANADA.
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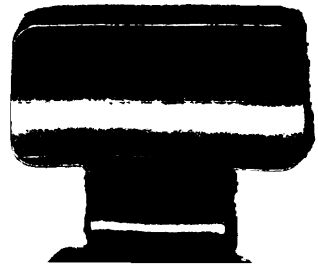

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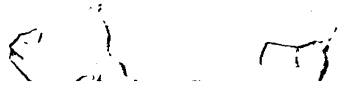

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1876.

This publication is intended to contain descriptions and figures of some of the organic remains of the Mesozoic rocks of the Dominion.

The present Part is devoted to a monograph on the Invertebrata collected by Mr. James Richardson from the Coal-bearing rocks of the Queen Charlotte Islands, in the summer of 1872.

The figures, Plates I. to X., have been drawn from nature and lithographed by Mr. A. H. Foord, F.G.S., the artist to the Survey.

ALFRED R. C. SELWYN.

GEOLOGICAL SURVEY OFFICE,
MONTREAL, *November 30th*, 1876.

# GEOLOGICAL SURVEY OF CANADA.

## MESOZOIC FOSSILS.

BY J. F. WHITEAVES.

## VOLUME I.

I. *On some Invertebrates from the Coal-Bearing Rocks of the Queen Charlotte Islands.*

### INTRODUCTION.

The Queen Charlotte Islands, to which exclusive reference will be made in these pages,* are situated about half way between the Vancouver group and Sitka, at a distance of eighty or one hundred miles from the mainland of British Columbia. Their geographical position, as laid down on the British Hydrographic Charts, is between latitudes 51° 54′ and 54° 22′ north; and longitudes 131° and 133°† 07′ west. The credit of the first discovery of these islands has been incorrectly assigned to La Perouse, or Captain Dixon, in some of the older encyclopœdias and gazetteers; nor are volumes of a much more recent date entirely free from similar errors. By far the most trustworthy account of the progress of discovery on the north-west coast of America yet published, is to be found at Part II., Chapter II., of Mr. W. H. Dall's able work, entitled "Alaska and its Resources." ‡ In answer to enquiries with reference to the authenticity or otherwise of supposed discoveries in this vicinity by Admiral Fuentes and others, and as to what was the vocation or rank of Juan Perez, Mr. Dall kindly forwarded the following historical sketch of the group, which, as it contains some unpublished facts and information which probably no other person could give, is gladly printed here, with his permission, and in his own words.

1. "The manuscript from which the so-called Voyage of Admiral Fuentes was made public, is now believed to be a forgery. It is certainly unsupported by any intrinsic evidences of truth, and is universally rejected by modern authors. The same remark will apply also to

* There is another group of the same name in the South Pacific.

† Printed 135°, by a typographical error, in Mr. Richardson's report.

‡ Boston: 1870.

151848

Maldonado, and many of the early geographical fictions. Fuentes s that, half way through the north-east passage, into which he sailed met a ship from Boston!"

2. "On the 25th of January, 1774, Ensign Juan Perez, formerl employed in the Manilla trade, sailed on the corvette *Santiago, from Sa* Blas, touching at Monterey, California, from which he sailed June 6th on an exploring expedition to the north, accompanied by Pilot Estevar Martinez, and Rev. Fathers Pena and Crespi, chaplains. The first land seen, July 18, 1774, was that of the Queen Charlotte Islands, in latitude 54°, to the north point of which Perez gave the name of Co. de S. Margarita, and to the high mountains, Sierra de San Cristoval. Finding no anchorage, they turned southward without landing, and on the 9th of August anchored in Nootka Sound. The authorities for this voyage are the narratives of Perez, observations of Martinez, and the journal of Friar Pena, MSS. copies of which were obtained from the Imperial Archives of Madrid, by the United States Government, in 1840. An account was also published in 1802, in the introduction to the voyages of the 'Sutil and Mexicana.' This was the first voyage made northwards by the Spaniards after 1603."

3. "Immediately after the return of Perez, Viceroy Bucarelli ordered another expedition to examine the coast as far as latitude 65°. Captain Bruno Heceta, in charge of the *Santiago*, with Perez as Ensign, and the schooner *Sonora*, in charge of Juan de Ayala, with Maurelle as pilot, in company with the schooner *San Carlos*, sailed from San Blas, March 15, 1775. The Captain of the *San Carlos* became insane before they were out of sight of land, and Ayala was detached to take his place, and stopped at Monterey, while Lieutenant Francesco de la Bodega y Quadra took his place in charge of the *Sonora*. Most accounts are erroneous in stating that Ayala accompanied the expedition northwards. (The authorities for this voyage are the MSS. accounts prepared by order of the Spanish Government immediately after the conclusion of the expedition, of the official narrative of the whole, including the journal of Bodega, and of Maurelle, part of the journal of Heceta, and a concise narrative by Bodega. These are represented by duplicates obtained from Madrid, and now in our State Department Library. A synopsis was published in Galiano's preface to the voyage of the *Sutil* and *Mexicana* in 1802. Barrington's translation of part of the MSS. was made before the official revision, and includes many errors.) The schooner was attacked by the natives near Destruction Island, north of Cape Mendocino: and being very unwilling to proceed, Heceta, in the *Santiago*, (with Perez) seized

the opportunity to return to Monterey. Bodega and Maurelle in the schooner *Sonora*, however, kept on their way. They saw Mount Edgecumbe about the middle of August, and afterwards landed in Port Remedios (the Bay of Islands of Cook) and, sailing down the coast, named the strait north of Queen Charlotte Islands, Perez Inlet, and coasted along (without entering bays, or landing) the shores of the said islands. They then returned to Monterey, doing a little surveying on the Oregon and Californian coast on the way.

Subsequently, Cook did not see the Queen Charlotte Islands."

4. "In 1786, La Perouse coasted along the shore of the Queen Charlotte Islands, and was the first to suggest their separation from the mainland. (Arteaga and Bodega, in 1779, did not visit them.) La Perouse, about August 18, 1786, (Vol. I., page 422,) coasted along their shores, and named (on his chart) in the N. part, Baie de Clonard, a bay in the south part, Baie de la Touche, the south cape—Cape Hector, and some small islands off it, 'Isles Kerouart.' He sailed to the eastward sufficiently to satisfy himself that a deep inlet extended between the islands and the mainland. His Isles Fleurieu are on the main coast, S. and E. of the Queen Charlotte Islands, and are the Princess Royal Islands of Vancouver. He gave no name to the Queen Charlotte Islands."

5. "In 1786, Captains Lowrie and Guise visited the Queen Charlotte Islands coast, but left no information on record in regard to it."

6. "In August, 1787, Dixon coasted along these Islands, landing nowhere, and named them for the first time, also calling the strait north of them after himself. Captains Colnett and Duncan sailed from Nootka to trade at these islands about the same time, and the following year, Duncan sailed through the strait between the Islands and the mainland, which had been assumed by the previous voyagers. He also named the Fleurieu Islands (of La Perouse) the 'Princess Royal Islands,' after his vessel."

7. "In 1789, Captain Robert Gray, of the sloop *Washington*, of Boston, explored the east coast of the Queen Charlotte Islands, which had not previously been visited by any white man, though Duncan had sailed through the strait, keeping more on the mainland shore. Gray called it Washington Island, being ignorant of Dixon's name. Afterwards, Douglas, the colleague of Meares, also visited this east shore."

8. "On the 29th of June, 1790, Captain Joseph Ingraham, of the brig *Hope*, anchored in a harbour on the south-east side of the Queen Charlotte Islands, which he called Magee's Sound, after one of the owners of his

vessel. His MSS. journal is referred to by Greenhow." * He spent the summer on this coast, and is the first white man, whom we have any account of as actually landing on these islands. All previous voyagers and coasters, for fear of the natives, had contented themselves with standing off and on near the shores, or anchoring at a distance, and trading from their vessels.

9. "The *Columbia*, Captain Gray, made a second voyage from Boston in 1790-91, and was occupied trading and exploring on the east coast of the Queen Charlotte Islands in August and September, 1791. He wintered at Clayoquot, and built a small vessel, the *Adventure*, which, under Gray's mate Haswell, sailed from Clayoquot, in the spring of 1792, for the Queen Charlotte Islands, and Gray himself, later in the season, returned there for trade."

On August 22, 1791, Captain Etienne Marchand, in the French ship *Solide*, which had visited Sitka Sound, made the entrance of Cloak Bay, between North and Graham Islands. While the vessel stood off and on, a boat party entered and explored the bay and adjacent Cox Strait. The bay had been seen and named by Dixon, and had been traversed by Gray, who first identified North Island as an island. Douglas afterwards anchored there, and has given a brief description of his observations; but the first chart, in detail, published of any of the Queen Charlotte Island harbours, was that prepared by Marchand's party.

The *Solide* subsequently visited the west coast of Graham Island for some distance to the southward, and then departed for Berkeley Sound.

10. "In 1792, the Spanish corvette *Aransasu*, Lieutenant Jacinto Caamano, sailed from San Blas, and explored the main coast between 50° and 53° North Latitude, but it does not appear that he touched at the Islands, as he was seeking a North East passage."

11. "In 1794, Vancouver, returning to Nootka, coasted along the West shore of Queen Charlotte Islands, which he had previously surveyed superficially in September, 1793, but the voyage of 1794 added nothing to information previously obtained."

"I can assure you of the correctness of the preceding notes, as I have verified them carefully. So you can set it down as certain that Perez was the discoverer, and Ingraham probably the first to land. Later voyages are few and mostly *very* modern; these you are doubtless familiar with."

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* "History of Oregon and California and other Territories on the North-West Coast of North America." By Robert Greenhow. 2nd edition. Boston: 1845.

Although the existence of coal on these islands has been long known, it is by no means certain by whom, or at what date, the discovery was made. Openings have been made upon the anthracite seams of Graham Island at several different localities, under the auspices of the Queen Charlotte Coal Mining Company, but these operations do not appear to have been very remunerative, and they have subsequently been discontinued.

In the summer of 1872, Mr. Richardson, of the Canadian Geological corps, visited the group, and devoted nearly two weeks to as careful an examination of the geology of the country near Cowgitz, as the time would permit. He brought back with him an interesting collection of the fossils, rocks, minerals and economic products of that region, and published a somewhat detailed account of his investigations in the Report of Progress for 1872-73. The fossil plants collected on this occasion have been submitted to Principal Dawson, who has contributed some notes upon them as an appendix to the report just referred to, which contains also some remarks on the Cephalopoda by Mr. Billings.

The accompanying map has been prepared to show the distribution of the Coal-Bearing rocks of the region explored, the boundaries of the divisions, and the localities from which the fossils were collected. An arm of the sea, called Skidegate Channel, separates Moresby and Graham, the two largest of the Queen Charlotte Islands. The western half of Skidegate Channel is very narrow, but on its eastern side it widens out and includes several smaller islands. The map shows the central and widest part of this channel (with Maud, Lina and several other small islands), which is bounded on nearly three sides by Graham Island; and its eastern opening called Skidegate Inlet. A portion of Moresby Island is also seen in the lower right hand corner.

The following brief account of the geology of this district is either condensed from Mr. Richardson's report cited above, or is derived from information directly supplied by him.

The Coal-Bearing rocks of the area represented on the map form a trough or syncline, of which only the edges are visible at the surface. At its western extremity, and probably also to the eastwards, the syncline is bounded by trappean rocks. The following divisions have been proposed for these sedimentary deposits, but the thickness of each series has not yet been ascertained:

1. Lower Shales, with Coal and Iron Ore.
2. Coarse Conglomerates.
3. Upper Shales and Sandstones.

1. The Lower Shales.—These consist of highly fossiliferous argillaceous shales, containing a small percentage of calcareous matter, interstratified with greenish or greyish sandstones, which are also very fossiliferous. The base of the series is characterized by the occurrence in it of seams of anthracite and beds of clay ironstone. So far as examined, the eastward outcrop of these shales makes a rudely S-shaped curve, which extends from the N.W. of Moresby Island across Skidegate Channel (or Inlet) to Graham Island, and includes South, Maud and Lina Islands. This edge of the syncline has a general westerly dip of from 9° to 30°.

The western outcrop of the Lower Shales has been traced across the N.W. arm (called Long Arm on the map) of Skidegate Channel, from the S. to the N. side, to the Queen Charlotte Anthracite Coal Mining Company's works at Cowgitz. The strata here are much contorted, but have a general easterly dip at a high angle. With the exception of one species, all the fossil shells were obtained from rocks of this division, the two outcrops of which are indicated on the map by the figures 1, 1. *Unio Hubbardi* was found abundantly in bituminous shale at Wilkes tunnel, near Cowgitz (F.): and specimens of a bivalve, probably *Inoceramus concentricus* of Parkinson, were collected at a small bay to the south of Christie Bay (F.): all the rest are from either Maud or Lina Islands. As the shales on these two islands belong to the same geological horizon, Mr. Richardson did not think it necessary to keep the fossils from each locality apart, and it is now impossible to separate them.

2. Coarse Conglomerates.—The line of strike of these beds runs parallel to that of the rocks of the previous division. The shaded portions on the map indicate the distribution of the conglomerates as actually observed, and the dotted lines which enclose figure 2, show their supposed extension under water. No lines of bedding were traced in these deposits, which appear to be unfossiliferous.

3. Upper Shales and Sandstones.—The position of these rocks is in the centre of the syncline. Their outcrop has been followed along part of the north shore of Skidegate Channel, on Graham Island, which forms the northern boundary of the space partly surrounded by dotted lines on the map. These last inclose a solitary 3, as well as Reef Island and Weed Rock. A few fragments of fossil plants were collected in the Upper Shales at one locality (F.), also two or three specimens of a shell

which may be *Inoceramus concentricus*, but which are so fragmentary, or else so much distorted, that their generic position even is uncertain.

Besides plant remains, which are of frequent occurence, the collection contains fourteen species of Cephalopoda, six of Gasteropoda, twenty-two Lamellibranchiate bivalves, two Brachiopoda and a Zoantharian coral. It will be most convenient to describe these fossils first, and to discuss their probable geological horizon afterwards, but it may be briefly stated here that there is an apparent mixture of oolitic and cretaceous types. This circumstance has necessitated double comparisons throughout, and has added not a little to the difficulty of the undertaking.

The sculpture of the shells is generally well preserved, but in consequence of the laminated structure of the matrix, most of the specimens have been subjected to such a variety of distortion and compression, that it is impossible to tell what their original shape was. In addition to this, they are frequently imperfect or broken, and as in many cases there is but a solitary example of each kind, it may easily happen that what now seem to be specific characters, may prove to be only individual peculiarities when a more complete series has been obtained.

The most striking and characteristic fossils of the Lower Shales belong to the class Cephalopoda. Ammonites, in particular, abound almost to the exclusion of other genera, but none of them belong to divisions in which the shells are either simply or crenately keeled. Out of eleven species, eight have rounded backs, one belongs to Pictet's subsection Mammillati, while the two remaining, although ranked among the Clypeiformes, have the periphery obtuse. Another noticeable feature in the Cephalopoda from these shales is, that the commencement of the decline of the group, as a whole, through the half coiled types of the Ammonite family, is rarely perceptible. Such genera as *Scaphites*, *Hamites*, *Baculites*, *Helicoceras*, *Turrilites*, and *Toxoceras* are almost unrepresented. The only exception is a small fragment which is very doubtfully referred to *Hamites*, but which may just as likely have been part of an *Ancyloceras*.

In describing the Ammonites from these rocks, the most recent modifications of the divisions proposed by Von Buch and D'Orbigny have been adopted as far as practicable. At the same time it must be admitted that this system of classification is very unsatisfactory in practice. Many Ammonites present a mixture of characters, and such species might be referred to two, or even three, of these sections, with equal probability. Others, again, which have been placed in two separate groups,

and apparently with good reasons for so doing, have proved to be only different stages of growth of the same shell.

The old genus *Ammonites* of Bruguiere, with its eight or nine hundred of so called species, is a heterogeneous assemblage, which requires division into several genera and subgenera. Stoliczka says, very truly, that the animals of *Turritella* and *Cerithium* are not in any way more different than must have been those of *Ammonites discus* and *A. Rotomagensis*. The whole of the group has been revised anew, on the principle just indicated, by Dr. Waagen and others in Germany, and by Prof. A. Hyatt, in America. The new generic or subgeneric names proposed by these authors will be adopted in this memoir, at least in those cases in which there is a reasonable probability of their being correctly applied.

Considerable differences of opinion have existed, and probably always will exist, with regard to what constitute specific differences in these shells. Those whose experience has been gained by a study of many specimens in the field, naturally attach less importance to minute differences in form, surface markings and the like, than is accorded to them by others whose opportunities for extended comparisons have been few. In this connection the late Prof. Phillips justly remarks* :—"The zeal of collectors, by procuring them (Ammonites) of all ages and under different circumstances, has given occasion to coin too great a number of specific names. Yet for the most part, the diversity of names for a given set of forms indicates something really different in the history of the species, and most of the designations may be retained as marking varieties worth discrimination. In making, some years since, a strict comparison of the ammonites of the Yorkshire lias with others from the south of England esteemed to be of the same species, I found often some small differences, especially in the sutures, which might be best understood as local peculiarities of race. Ammonites to be really known as species, must be studied with many examples of every age, including the very young and the very old; the change of form in the course of life being often very great and remarkable."

In the present instance it has been impossible to comply with the conditions stated in the last sentence of the above quotation. Several of the species in this genus, for which new names will be proposed in these pages, are founded on a single imperfect specimen, and in no case has a large series been obtained. The same, indeed, may be said of all the shells in the collection. The septation, too, which, when properly studied, is

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* "Geology of Oxford and the Valley of the Thames." Oxford: 1871. Page 131.

of great assistance in determining the specific relations of Ammonites, is rarely shown in these Queen Charlotte Island fossils.

The Gasteropoda obtained by Mr. Richardson are very few in number, and the specimens are almost always fragmentary or badly preserved.

Lamellibranchiate bivalves are abundant, both in species and individuals. The surface markings of these shells are often well shown, but the characters of the hinge teeth, and the impressions on the interior of the valves can rarely be ascertained. The family Hippuritidæ has no representatives; *Vola* and *Spondylus* are also absent, and there is only a single species of *Inoceramus*.

Brachiopoda are extremely scarce, only four broken and exfoliated specimens were collected. which belong apparently to two species.

The solitary coral is a compound Zoantharian, belonging to the family Astræidæ.

Out of forty-two species of Mollusca proper, three (*Ammonites Brewerii*, *A. Stoliczkanus* and *Aucella Piochii*) are well-known Californian fossils. *Aucella Piochii*, however, is probably identical with the *Aucella Mosquensis* of Europe. *Unio Hubbardi*, Gabb., is abundant at one locality in the Queen Charlotte Islands: it was originally described as from Vancouver Island, probably by mistake. It is the only fresh-water mollusk in the collection, and is, perhaps, the same as the *Unio aduncus* of Sowerby, from the Wealden deposits of England. Besides these, seven others are either very nearly related to European or Indian species, or are actually identical with them. The rest seem to be new to science, but the specimens are sometimes so imperfect, that it is not thought desirable to propose any specific names for them.

Without wishing to introduce any innovations in the use of terms, or to criticize the descriptions of others, it becomes necessary to define the sense in which certain expressions will be used here, as the same words have been employed to convey very different and even opposite meanings.

It has long been customary with palæontologists to call the outer edge of the shell of a Nautilus or Ammonite, the *dorsum*, and some still continue to do so. According to Prof. Hyatt, "the position of the female Argonaut in her shelly case, and of the Nautilus in its shell, show conclusively that the periphery of the whorls of an Ammonite is the abdominal side, as stated by Richard Owen and Pictet." For this reason, Mr. Hyatt and some other writers call the outer margin of such shells, the ventral, and the inner, the dorsal region. To prevent any misapprehension which might otherwise arise, the term *dorsum* will be purposely avoided. Such phrases, as the *outer edge* of the shell of a

Nautilus, or the *siphonal edge* of that of an Ammonite, can scarcely be misunderstood, while the word *periphery* will suit either indifferently.

The expression *aperture*, as applied to these fossils, is purposely chosen to describe the shape of the whorl at or near its outer termination, as viewed transversely; but not necessarily that of the true outer lip of the shell. The *height* of the aperture will be measured from the centre of the periphery of the outer whorl to that of the one which precedes it; the *width*, at a right angle to the height.

In describing the shells of Gasteropoda, the adjective *transverse*, when applied to ribs or striæ, is intended to mean transverse as to the whorls, and not as to the axis of the shell.

To preserve a certain consistency throughout, the *height* of lamellibranchiate bivalves will be measured, as nearly as possible, in the direction of a line drawn perpendicularly from the hinge line or dorsal margin, to the opposite or ventral border. The *length* will be estimated at a right angle to the height, and the *width* or *breadth* as equal to the maximum thickness through the closed valves.

As the valves of the Brachiopoda are respectively dorsal and ventral, the *length* of these shells will be measured from the beak of the pedicelled valve to its opposite extremity, while the *width* will correspond to the space between the two margins of either valve, at a right angle to the height.

Throughout these descriptions, the word *diameter* must be understood to imply the distance between two points, as measured on a flat surface.

Geographical names and others which, according to Dr. Johnston,* have a "reminiscential evocation," have been freely proposed for fossils which are believed to be new, especially in the case of genera, such as *Ammonites*, in which the number of species is already so large that it is almost hopeless to expect to find descriptive names which are not preoccupied.

In conclusion, the writer desires to express his cordial thanks to Mr. W. H. Dall, of Washington, who has kindly made and forwarded tracings of figures as well as copies of descriptions of certain fossils from books not at present accessible in Montreal, and for various critical suggestions; to Mr. F. B. Meek, also of Washington, who obligingly sent photographs of drawings made from the original types of species from Vancouver and Sucia Islands, described by him; to Mr. Richardson for information as to the exact stratigraphical position and localities of the fossils which he collected; and to Mr. A. H. Foord, for the pains he has taken in the delineation of the features characteristic of the different species.

* "British Zoophytes." Second Edition. Vol. I., page 164.

# DESCRIPTIONS OF SPECIES.

## CEPHALOPODA.

### BELEMNITES. (Sp. undt.)

Plate I., figs. 1*a*,, 1*b*. and 1*c*.

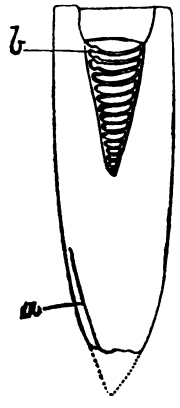


FIG. 1.

FIG. 1.—*Belemnites, species.* Outlines of a longitudinal section of the best specimen collected. The position of the apical groove is seen at *a*, and indications of what is supposed to have been the siphuncle, may be traced at *b*. The restoration of the point is purely hypothetical.

Three more or less fragmentary specimens of a Belemnite of medium size, which collectively show many of the characters of the guard and phragmocone. As each of these exhibits some peculiarities which are not seen in either of the others, it will be best to describe them separately.

No. 1 is a portion near the anterior (or thickest) end of the guard, about an inch and a half in length, and partly imbedded in shale. The specimen is broken transversely below and obliquely above, so as to give two natural sections at different angles. The outline of the transverse section is ovately orbicular, the sides being distinctly compressed. The lateral diameter is nearly one-sixth less than the dorso-ventral; the measurements being about five and a half by six and a half lines. The

tangential section shows only that the septa of the phragmocone are rather more than a line apart at the widest end.

No. 2 is also a fragment near the anterior end of the guard, but it is entirely free from any investing rock. As viewed transversely, its outline is more nearly circular than that of No. 1, and its sides are less distinctly compressed. The measurements in this instance are seven by scarcely six and a half lines across. The phragmocone (Plate I., fig. 1*a*) which is loose in this specimen, is elongately but inversely conical and inequilateral, with the apex distinctly eccentric. Its length is about thirteen lines; its greatest width nearly six lines, and its least, less than one. At its widest end it is ovate-orbicular in section, as is also the alveolar cavity; the presumed bulbous termination is broken off. Judging by faint lines on the cast, the septa appear to be slightly oblique and very numerous; they are about a line apart at the widest end, and at least four times as close together at or near the point.

No. 3 (Plate I., fig. 1) is the most perfect example yet procured, and like the first, is entirely free from the matrix. Its length is an inch and three-quarters, its greatest width seven lines, and its least, scarcely six. The anterior extremity of the guard contains more than two-thirds of the alveolar cavity, (as compared with No. 2) and at the opposite end wants only the extreme apex. In this specimen the sides of the guard are more decidedly compressed than they are in either Nos. 1 or 2. The guard itself is sub-cylindrical, and does not decrease in size perceptibly, until about an inch from the tip, when it begins to narrow unequally and rather suddenly. The apex being broken off, it is impossible to tell whether the tip was obtusely pointed or shortly acuminate, but the contour of the remaining part shows that it was slightly eccentric. At or near the tip there is a faint and inconspicuous groove, which probably measured about seven lines, if we allow two or three for the piece broken off. The compression of the guard is a little oblique, so that the outline of a transverse section at the anterior end is elliptic ovate, one end being a little wider than the other. The apical groove is placed, not on either of the flattened sides, but in a direction corresponding to that of the widest end of the ovoid.

A longitudinal section of this specimen, kindly made by Mr. Weston, of which Fig. 1 is a representation, revealed some additional particulars. The entire length of the guard is twenty-one lines, and of this the phragmocone occupies ten lines. The apex of the phragmocone is slightly eccentric, and seems to point in the same direction as does that of the guard. Traces of what is supposed to be the siphuncle were detected

crossing some of the upper septa of the phragmocone, and it would appear that the siphuncle is placed on the same side as that towards which the apices of the guard and phragmocone point.

Mr. S. P. Woodward says* that the apex of the phragmocone of a Belemnite points to the ventral side of the guard, and if this be uniformly the case, then, in this species both the siphuncle and the apical groove are probably ventral. M. Duval Jouve, † however, maintains that in some of the Neocomian Belemnites the siphuncle is dorsal, and in others ventral. Hence it is by no means certain that the apical groove, or the siphuncle of this species, are ventral, but both seem to be situated on the same side, and that the one towards which the apices of the guard and phragmocone point.

In his remarks upon the Queen Charlotte Island Cephalopoda already referred to, Mr. Billings says that these small Belemnites belong to the sub-section Acuarii of Bronn's section Acæli, also that they are "closely allied" to the *Belemnites Russiensis* and *B. Kirghisensis* of D'Orbigny, two species which are described and figured in Volume II. of Murchison Verneuil and De Keyserling's "*Geologie de la Russie et des Montagnes de l'Oural.*" In both of these opinions the writer entirely concurs, but the Belemnites collected by Mr. Richardson are apparently distinct from both of their Russian analogues. The guard of *B. Kirghisensis* is represented as much longer and slenderer than is that of the present species, and in *B. Kirghisensis* the apices of the guard and phragmocone point in opposite directions. The general shape of the guard of *B. Russiensis* is certainly very like that of the fossil now under consideration; but in the Russian Belemnite the apical groove is placed on one of the flattened sides, which, moreover, appear to be respectively dorsal and ventral.

No traces of a slit down the anterior end of the guard could be detected, nor any indications of a corresponding raised rib on the phragmocone, so that these specimens can scarcely be referred to D'Orbigny's genus Belemnitella, but to Belemnites proper.

The specific characters of these Belemnites are so imperfectly shown in the few fragments yet obtained, that it is not thought desirable to propose a new name for them, although they cannot be satisfactorily referred to any known species, and are probably new to science. The peculiar compression of the guard may be due to the distortion to which so many of these fossils have been subjected.

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* "Manual of the Mollusca." Page 73.

† "Monograph of the British Belemnitidæ." By Prof. Phillips. Part II., page 30. Palæontographical Society: 1866.

### Belemnites. (Sp. undt.)

Besides the three specimens described above, a tolerably complete phragmocone and a portion of another were collected, which must have belonged to Belemnites of considerable size. Mr. Billings describes the most perfect of the two as follows:—"It consists of a portion of a large phragmocone, two and a half inches in length, one and a half inches across the larger extremity, and thirteen lines across the smaller. The septa are moderately convex, and there are twelve chambers in the specimen." Little can be added to this description; the measurements have been tested and found essentially correct, though the diameter of the smaller end seems nearer to twelve than to thirteen lines. These fragments may indicate the existence of a second species at this locality, or they may represent merely the adult stage of the one first described. The evidence is altogether insufficient to show which of these views is the correct one, though the latter is, perhaps, the most probable supposition.

### Nautilus. (Sp. undt.)

**Perhaps N. elegans, D'Orbigny,* but not of Sowerby.**

**Or, possibly, N. pseudo-elegans, D'Orbigny.†**

Shell (or rather cast) inflated, globose; maximum thickness not much less than the entire diameter, the proportions being nearly as five to seven; umbilicus either very small or entirely closed, most probably the latter. Most of the inner septa are crushed out of shape, but the outline of the outer one is concave and simple; the position of the siphuncle is unknown. Aperture transversely reniform or sublunate, rather deeply emarginate by the preceding volution. Measuring from the periphery to the centre of the margin of the next whorl, where the emargination is greatest, the height of the aperture is much less than its width. The surface of the cast is ornamented with transverse radiating ribs, which at first curve convexly forwards across the sides, and then backwards, so that each one forms a shallow, but rather angular sinus on the periphery. The ribs appear to run exactly parallel with the true outer lip of the shell, and their forward curve is

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* "Paléontologie Française. Terrains Crétacés." Vol. I., page 87. Atlas, Plate XIX.

† " " " " Vol. I., page 70. Atlas, Plates VIII. and IX.

greatest near the aperture. They are narrowest at the umbilicus, and widen gradually towards the periphery, where they measure about two lines in width.

Greatest diameter, about seven inches; approximate width of aperture, (which coincides with the maximum thickness at a right angle to the diameter) slightly over five inches; height of aperture, in the centre, three inches and seven lines. The specimen being very much distorted, these measurements must be received with caution.

One of the most striking specimens in Mr. Richardson's collection is the large Nautilus described above. Unfortunately this unique example is badly preserved, and very much crushed out of shape. The siphuncle is not visible anywhere, although the fossil happens to be broken in two pieces, in such a way as to expose most of the interior. The distortion is greatest in the chambered part of the shell, so that it is impossible to tell how many septa there were to a volution, or to define their exact shape.

The species is very nearly related to the *Nautilus elegans* of D'Orbigny, and to the *N. pseudo-elegans* of the same author; but it may prove to be distinct from both.

It is clear that the Queen Charlotte Island fossil is not the *Nautilus elegans* of Sowerby, for in that shell the aperture is said to be "obtusely sagittate, with the posterior angles truncate." The description and figures in the "Mineral Conchology" give one the idea of an obliquely compressed shell, with an aperture whose height is much greater than its width. Before the writer was aware that Pictet had shown that the *Nautilus elegans* of D'Orbigny and Sharpe is distinct from the *N. elegans* of Sowerby, the same conclusion had been arrived at after a careful study of the original diagnoses. D'Orbigny describes his *N. elegans* and *N. pseudo-elegans* as follows, Italics being substituted for Roman letters to emphasize certain points:—

Nautilus elegans, D'Orbigny (as of Sowerby).

"N. testâ *globulosâ inflatâ*, transversim sulcatâ; sulcis incurvis, reflexis, umbilico impresso, *non perforato*; aperturâ latâ, semilunari; septis simplicibus, arcuatis; siphunculo ad tertiam exteriorem septorum partem perforato."

Nautilus pseudo-elegans, D'Orbigny.

N. testâ *discoideâ, inflatâ*; transversim undulato-sulcatâ, *subumbilicatâ;* aperturâ semilunari; septis arcuatis, in umbilico sinuosis; siphunculo non centrali ad inferiorum limbem septorum adplicato."

The following remarks are added to the description of *N. pseudo-elegans*:—" rien de plus facile que de la confondre extérieurement avec le *Nautilus elegans* de Sowerby. En effet les deux espèces sont lisses dans le jeune âge, et sillonnées à peu près de la même manière dans l'âge adulte: mais elles sont néanmoins entièrement différentes. Le *Nautilus pseudo-elegans* se distingue du *Nautilus elegans par son dos plus large*, et surtout par ce caractère invariable, que la siphon est placé au tiers intérieur de la hauteur de la bouche, près du retour de la spire, au lieu de l'être au tiers exterieur ou près du dos, comme il l'est toujours dans le *Nautilus elegans*."

As the position of the siphuncle is unknown in the specimen from the Queen Charlotte Islands, the question naturally arises, is it possible to distinguish *N. elegans* (D'Orb.), *N. pseudo-elegans*, and closely related species, by any other characters? Judging by the descriptions in Latin, *N. elegans* would seem to be a thicker and more ventricose shell than *N. pseudo-elegans*, but the italicised remarks in French, and the figures in the "Paléontologie Française" convey just the opposite impression. Sharpe states that *N. elegans* (D'Orb.) "is the most globose shell of the group, and has the smallest umbilicus." His figure (Cephalopoda of the Chalk Formation, Plate III., fig. 3) is almost an exact portrait of the specimen obtained by Mr. Richardson, and the dimensions which Sharpe gives of his fossil ("diameter six and a half inches, breadth five inches,") accord remarkably well with those of the present shell. These statements, as well as the impressions conveyed by the figures, are, however, negatived by the remark that "the two species are so much alike, that the *only* character to be relied on for distinguishing them is the position of the siphuncle." It follows that the exact specific relations of the Queen Charlotte Island fosssil cannot be ascertained until more perfect examples have been obtained. Blanford says that there are fourteen septa to the whorl in *N. elegans*, (D'Orb.) and that in *N. pseudo-elegans* there are twenty in the same space. In the Queen Charlotte Island specimen it is impossible to ascertain whether the septa were originally distant or approximating.

Pictet and Blanford have shown that the position of the siphuncle in certain European and Indian cretaceous Nautili is not invariable in the same species. Some Nautili, also, which agree in the position of the siphuncle, differ materially from each other in external form. For these reasons there is a tendency among palæontologists to regard *N. elegans* (D'Orb.) and *N. pseudo-elegans* as varieties of one species. Still, most authorities have pronounced themselves in favour of their distinctness,

among whom may be mentioned Pictet, Cornuel and Blanford, as well as D'Orbigny and Sharpe. Should the latter view be adopted, the laws of nomenclature require (as Blanford has pointed out) that D'Orbigny's name should be changed, as it is preoccupied. It might have been a fitting compliment to the Swiss naturalist who first called attention to its distinctive features, to have dedicated the species to him, but Oppel has already called a Nautilus from the Upper Tithonic beds at Stramberg, *N. Picteti*. This being the case, the name *N. Atlas* is proposed as a substitute for that of *N. elegans*, D'Orbigny. The Queen Charlotte Island specimen may or may not belong to the same species.

A Nautilus collected by Mr. Richardson, in 1874, from the Cretaceous rocks of Sucia Island, which is in an excellent state of preservation, (although a little distorted) bears a striking resemblance in many respects to the type of *N. Atlas*. It is a much less globose shell than the Q. C. Island specimen; its umbilicus is entirely closed, and the siphuncle is situated a little on the outside of the centre of the septa. Eight septa are visible externally in the space of rather more than half a whorl; the ribs on the inner, or nacreous layer of the test, are proportionately broader than are those of the Q. C. Island shell, and they each form a wide but not angular sinus on the periphery. There is a distinct though not very large excavation round the umbilical callus. Near the aperture, the height of the whorl, outside of the emargination caused by the encroachment of the preceding volution, is not much less than its breadth. The dimensions are about as follows, but no allowances have been made for obvious distortion:—

Greatest diameter, four inches and one line; width of aperture (which is identical with the maximum of thickness) two inches and five lines; height of do., in the centre, eighteen lines.

This fossil will be described more at length in another place, but its prominent characteristics are given in advance for the sake of comparison. The siphuncle of this shell seems to be placed rather nearer to the centre of the whorl than is the case with *N. Atlas*. The Sucia Island fossil is very nearly related to *N. Atlas*, of which it is probably only a variety; the Q. C. Island specimen, on the other hand, may prove to be nearer to *N. pseudo-elegans*.

The few Nautili of the section Radiati, which have yet been described or quoted as occurring in the Cretaceous rocks of the United States, present curiously close affinities with European species. The apparent specific relations of the former may be thus briefly expressed, though

an examination of the type specimens would be necessary for a satisfactory comparison. The group, as a whole, may be conveniently arranged as follows:—

A. Umbilicus small, or entirely closed.

B. Umbilicus comparatively large.

1852. "Nautilus elegans, Sowerby."

Rœmer's "Kreidebildungen Von Texas," page 37, No. 37.

No description or figure of this shell is given, and all that is stated is that "some imperfect specimens from the waterfall of the Guadaloupe, below New Brauenfels, plainly show the peculiar, undulating, arched ribs on the surface, characteristic of this species."

1860. Nautilus Texanus, Shumard.

Transactions of the Academy of Sciences of St. Louis. Vol. I., page 190.

As the specimens from which this species was described are mere fragments, which do not show the characters of the umbilicus, it is not certain to which of the divisions proposed above it should be referred.

The shape of the aperture of *N. Texanus* is not unlike that of *N. elegans*, (Sow.) but the position of the siphuncle is the same as in *N. pseudo-elegans*, the species with which Dr. Shumard compared it.

1862. "Nautilus elegans, Sow., var. Nebrascencis," Meek.

Proceedings of the Academy of Sciences of Philadelphia for 1862, page 25.

In the paper where this Nautilus is described, Mr. Meek, naturally enough, seems to have taken the correctness of D'Orbigny's and Sharpe's identifications for granted, without further inquiry. The description of the Nebraska fossil, at least, accords much better with that of *N. Atlas* (nobis) than with Sowerby's diagnosis of his *N. elegans*. The globose shape, together with the position of the siphuncle in the American shell, are in favour of this view, but it is possible that the varietal name, proposed by Mr. Meek, may have to be raised to specific rank, as the sculpture of the so-called "variety *Nebrascensis*" is said to consist of ribs which are "five times as broad as the grooves between," and in this respect it differs from *N. Atlas*, as well as from nearly related species.

1864. Nautilus Texanus (?) "Shumard." (Gabb.)

"Palæontology of California." Vol. I., page 59] Plate IX., figures 3*a*. *b*.

There are some reasons for doubting whether the Californian shell, described and figured in the work quoted above, is correctly referred to Dr. Shumard's species. The siphuncle appears to be placed differently in the two shells; in *N. Texanus* (Gabb.), it is said to be situated above the centre of the whorls, as is the case in *N. Atlas*; in *N. Texanus*, (Shumard) its position is described as below the centre of the volutions, as in *N. pseudo-elegans*.

It is most likely that *N. Nebrascensis*, Meek, *N. Texanus*, Gabb (non Shumard), and the Sucia Island *Nautilus* are all forms of one variable species.

The discovery of such forms as *Nautilus spirolobus*, Dittmar, in the "Hallstadten Kalken" (or Trias) of Rossmoos, near the Lake of Hallstadt, of *N. Mojsisovicsi*, Neumayr, in the Middle Oolite of Poland, and of the *N. Asper*, Zittel, a species closely allied to the present fossil, in the Upper Tithonic beds of Moravia, has recently proved that the ribbed Nautili are by no means exclusively confined to the Cretaceous rocks, as was formerly supposed. Still, they are eminently characteristic of the Chalk Formation, in which they attained their maximum of development as a group.

## AMMONITES.

### *Group I.*—Clypeiformes, D'Orbigny.*

Sub-genus Oppelia, Waagen.—"Geognostisch-Palæontologische Beitrage." Von Dr. E. W. Benecke. Page 250. Munchen: 1869.

#### Ammonites Perezianus. (N. Sp.)

Plate II., figs. 1 and 1*a*.

(Perhaps a variety of Oppelia Waageni, Zittel. See "Die Fauna der Aelteren Cephalopoden Fuehrenden Tithonbildungen," by Dr. Karl Alfred Zittel. Cassel: 1870] Plate XXIX., figs. 1*a*. and 1*b*.)

Shell discoidal, lenticular, thin; umbilicus small; surface ornamented by broad, faint and transverse folds.

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* The numbers attached to these groups refer only to the present collection. The order is nearly that adopted in the "Palæontologia Indica," but the Ligati are placed between the Planulati and Fimbriati, instead of before the Planulati. In the case of the Ammonites only, a short definition of the salient characters of each species is prefixed to the more detailed description.

All the inner volutions are covered by the last whorl, excepting only their umbilical faces. Outer whorl nearly flat, or only slightly convex at the sides; periphery narrowly rounded and obtuse; inner edges of the volution oblique, almost confluent with the sides, the point of junction being marked by a faint, rounded shoulder. Aperture narrowly elliptical, deeply emarginate by the preceding volution. The height of the aperture, as measured where the emargination is deepest, is more than twice its width. Umbilicus small, shallowly funnel shaped, rather deeply conical in the centre, but spreading rapidly and obliquely in the outer whorl, especially near the mouth. Umbilical margin almost obsolete, sutures (of the volutions) indistinct, not excavated or channelled.

Surface marked by very faint and inconspicuous, transversely radiating plications. These are undulating, broad and rounded, but not much raised, and are about equal in width to the shallowly concave depressions which separate them. The folds are most prominent on the outer half of the sides; they seem to be obsolete on the periphery and are certainly so on the inner faces of the whorls.

The adult and unique specimen figured on Plate II. is much water-worn on the only side in which the septation is visible, and the finer ramifications of the sutures have been obliterated. There are indications of six or seven lobes in the septum nearest the mouth, and of these the four or five inner ones appear to have been simply toothed but not branched. Those placed near the periphery do not seem to have been very complicated in their structure. The "chamber of habitation" occupies nearly three-fourths of the outer whorl.

Greatest diameter, three inches and nine lines: width of umbilicus, as measured from the junction of the sides with the inner surface of the body whorl, nine lines; or, from suture to suture, five lines. Height of aperture, at the point where the emargination is greatest, one inch and nine lines: greatest width of do., ten lines. Depth of emargination of the outer whorl, eleven lines.

When the drawings were made, nearly the whole of one side of the fossil was covered by a nodule of shale. After the plates which contain figures of this species were printed, the matrix was removed from the specimen, and some new information was thus obtained which has been incorporated into the above description. The outline of the aperture (figure 1a) was found to be incorrect in two particulars. First, the emargination is not nearly deep enough, and secondly, the periphery,

(which happens to be water-worn in the original) is represented as too narrow and acute.

*Ammonites Perezianus* is nearly related to *A.* (*Oppelia*) *subcostaria* * Oppel, and particularly to *A.* (*Oppelia*) *Waageni* of Zittel. The former is represented as having a more rectangular umbilicus than *A. Perezianus* as well as fewer and more distant folds on the sides of the outer whorl. Both have thicker shells than the species just described, and *A. Waageni* is depicted as having an entirely smooth surface. On the other hand, the only specimen of *A. Perezianus* yet procured is a little crushed, and there is reason to suppose that its whorls were thickest near their middle, so that the shape of the shell was nearly, if not quite, lenticular in its normal state. Even supposing this to have been the case, *A. Perezianus* is a thinner and flatter shell than *A. Waageni*, and the difference between the sculpture of the two may be of specific importance. Under all the circumstances, it seems desirable to propose a provisional name for the species, and the one suggested is intended to help to perpetuate the memory of the first discoverer of the islands at which the fossil was collected.

### Ammonites Brewerii Gabb.

Plate 1, figures 2, 2*a*, and 3, 3*a*.

Ammonites Brewerii Gabb.—"Palæontology of California," Vol. I., page 62, Plate X., fig. 7. Also Vol. II., page 130, Plate XX., fig. 5.

The Ammonites from the Queen Charlotte Islands which are believed to belong to this species, present two strongly marked varieties. The specimen represented at fig. 2 † is the largest individual of what may be fairly regarded as the typical form, as it corresponds exactly with Mr. Gabb's amended description of his *A. Brewerii*, although the original figures of the adult have a strongly ribbed surface, whereas that of normal examples collected by Mr. Richardson is either smooth, or ornamented only by faint, sinuous, transverse striæ. Figure 3, on Plate I., is a portrait of the most perfect of two specimens of what seem to be a dwarfed variety of this shell, presenting characters, (such as a comparatively large umbilicus, strong rib-like folds, &c.) which are usually only seen in much larger individuals. It will be convenient to consider each form separately, and as the only work in which *A. Brewerii* was described

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* "Geognostich-Palæontologische Beitrage." Von Dr. E. W. Benecke. Zweiter Band. Heft 2, page 219 Plate XIX., figs. 2-5.

† On Plate I.

may not be accessible to some of the readers of these pages, the salient features of both will be briefly particularized.

*General characters.*—Shell discoidal, compressed, periphery narrowly rounded; umbilicus rather small, step-shaped and rectangular: surface marked either by flexuous, transverse striæ, or by rib-like folds.

1. *Presumed typical form.*—Shell discoidal, compressed, but not very thin, the maximum width of the outer whorl being only one third less than its height. Volutions four, the inner ones flat, smooth and nearly two-thirds covered by those which succeed them. Outer whorl with somewhat flattened but slightly convex sides, the greatest thickness being a little below the middle; periphery rounded: inner edge of the volution cut squarely at a right angle to the sides; umbilicus step-shaped, rather less than one-fourth of the entire diameter; aperture elliptical or narrowly oval, truncate below, higher than wide, deeply emarginate by the preceding volution.

Surface ornamented by faint, flexuous, and slightly raised, transversely radiating striæ, which are usually arranged in two sets. What may be conveniently called the primary striæ start from the umbilical margin, and pass completely over the sides, but become indistinct or obsolete on the periphery. Commencing at the umbilicus, their general direction is first a little forwards, then backwards, and again forwards, until at last they form moderately convex but very faint arches over the periphery. Near their junction with the umbilicus they are often seen to be made up of two or even three separate raised lines, which coalesce about the middle of the sides, between which point and the periphery they always become most prominent, fold-like and distant. The secondary striæ, which usually alternate with the primaries, radiate from the umbilicus, but extend only half way across the sides. There is generally a single secondary striation between each pair of primaries, but there are sometimes two, and at others none at all. Besides these markings, there are numerous faint and short striæ on the periphery, but these disappear before reaching the sides. The striæ on the siphonal edge are much finer even than the secondaries, and seem to be distinct from them.

Greatest diameter of the shell, four inches and two lines: width of umbilicus about one inch. Width of aperture (which is identical with the maximum of thickness) nearly fifteen lines: height of do., outside of the emargination caused by the preceding whorl, twenty-three lines: depth of the emargination, six and-a-half lines.

The above description and measurements refer exclusively to the largest

specimen collected. Six others were obtained; one a very immature individual, about an inch and a quarter in diameter; and five of an intermediate and almost uniform size, which measure from two to two and a half inches across. The smallest shell is entirely smooth; the medium sized ones are only faintly striated across the whorls. These latter differ from the specimen figured, in the following respects: they are much thinner and flatter proportionately, their periphery is narrower, and their umbilicus is smaller as well as shallower. Such half-grown shells resemble the *Ammonites Haydenii* of Gabb very closely, but their periphery is not "nearly flat" and somewhat squared, as it is in that species, but narrowly and evenly rounded. Externally there are very few characters by which they may be distinguished, but the septation is said to be different in Californian examples of the two species. The septa are not visible in any of Mr. Richardson's specimens.

2. *Dwarfed costate variety.*—Figs. 3 and 3*a* on Plate I. represent the most perfect specimen obtained of this form, the other being a mere fragment. Its greatest diameter is two inches and five lines: the width of its umbilicus, eight or nine lines: the maximum thickness, seven lines. The fossil is, however, considerably distorted. It differs from the more typical form less in shape than in sculpture. The latter consists of simple, transverse and flexuous, rib-like folds, which are most prominent on the outer half of the sides. They form distinct, narrowly rounded, convex arches over the periphery and are faintest near the umbilicus. The elevations are usually narrower than the shallowly concave grooves which separate them. Sometimes a short rib occurs between two of the ordinary ones, but when this is the case it generally forms a short arch over the periphery and does not reach to the umbilicus. The folds also show a tendency to bifurcate over the periphery, and there are some other unimportant and exceptional variations. The greatest thickness of the whorls in this variety is a little above the middle of the sides.

*Ammonites Brewerii* was first described from the "Shasta Group" of Cottonwood Creek, Shasta County, California, where it appears to be tolerably abundant. Until Mr. Richardson collected the specimens described above from the Islands in Skidegate Channel, the species had not been obtained from any other locality.

*Ammonites difficilis* of D'Orbigny, a French Neocomian fossil, is its nearest European representative. Both *A. difficilis* and *A. Brewerii* are very abnormal representatives of the Clypeiformes, but as D'Orbigny and

Pictet place *A. difficilis* in this section, *A. Brewerii* is included in it also. The latter palæontologist says that *A. difficilis* "makes a transition" to the Ligati.

*Group II.—Mammillati, Pictet.*

AMMONITES STOLICZKANUS, GABB.—Variety spiniferus.

Plate III., fig. 3, and Plate IV., fig. 1.

A. Stoliczkanus, Gabb. "Palæontology of California." Vol. II., page 135. Plate XXIII., figs. 16, 16*a*.

FIG. 2.

FIG. 2.—Ammonites Stoliczkanus, Gabb., var. spiniferus. Fragment showing the spinous nature of the tubercles.

Shell thick; whorls wider than high, compressed on the siphonal edge and inner half of the sides; umbilicus not very large, but deep; surface heavily costate; ribs tuberculate, except on the centre of the periphery.

Whorls five, increasing rather rapidly in size, about one-half of the inner ones being exposed. The volutions are always broader than high; in a well-preserved specimen an inch in diameter, they are distinctly

though obtusely bicarinate on the periphery, and obsoletely keeled at the sides. With the increase of growth the keels disappear, and the whorls become more rounded, until finally the last one assumes a subquadrangular aspect. The inner half of the sides of the body whorl is compressed, the outer half curves convexly and rather obliquely towards the periphery, which is broad and flattened. The umbilical face of this volution is squarely as well as very deeply truncate, and forms a blunted but nearly right angle with the sides. In the last whorl but one, the umbilical face is not straight, but slightly convex, and the angle between it and the sides is rounded off. All the specimens are so much distorted that it is difficult to estimate the proportionate width of the umbilicus with much accuracy, but in the example represented on Plate III., which is not fully grown, it is about one-third of the greatest diameter. In the adult the last whorl increases very much in height, so that the umbilicus may then be rather smaller in proportion to the shell. The aperture is transversely subquadrangular, the outer angles being broadly rounded; its height is rather less than its breadth, and the emargination of the base is not very deep.

The sculpture consists of broad, but not acute, raised ribs, and these are ornamented with tubercles, some of which originally bore long spines. In the inner whorls the ribs are straight, but in the last volution they are slightly flexuous. In the specimen previously referred to as being about an inch in diameter, the sculpture of the early whorls is well exhibited. At the commencement of the outer volution of this individual, each rib bears four tubercles, but when it is completed there are eight to each rib; the process of a gradual division of each tubercle into two separate ones being very clearly shown. At this stage of growth the tubercles are prominent, acute, and are separated into two sets by a shallowly-grooved space on the periphery. In the penultimate whorl the number of tubercles on each rib is generally twelve, or six on each side, and there are never more than these. They are usually situated at unequal distances from each other, and are separated by a flattened but not grooved space on the periphery.

It is only just to the artist to say that the spinous nature of some of the tubercles was discovered after the plates which contain figures of this species were printed. While attempting (subsequently) to remove the matrix from a broken example, a fortunate blow of the hammer exposed three long spines, two of which are very perfect. This specimen, which is represented in the woodcut (fig. 2), is a fragment, consisting of about two-thirds of the penultimate whorl, and a portion of the preceding

one. In this instance each spine arises from the inner margin of the smaller whorl; they are at first pressed a little downwards, and then curve upwards so as to rest against the umbilical wall, though they scarcely reach to its margin above. One of the spines is fully half an inch in length; it is flattened and rather obtusely pointed. The compression of the spines and their peculiar curvature are obviously the result of abnormal compression or distortion. Traces of spines were afterwards observed in other specimens, but all the additional information afforded is that they sometimes proceed from the outer as well as the inner parts of the sides, that they are occasionally acuminate, with a dilated base and slender point, also that they are often covered up by the whorls as the shell increases in age. In every place where they were traced, they were found to be protected from injury by the support afforded by the inner margin of the whorl next to the one on which they were placed.

Most of the tubercles become obsolete or disappear on the body whorl, excepting only a row of large ones round each umbilical margin, and another of much smaller size, placed about the middle of the sides. The ribs on this volution are alternately bifurcating and simple, but they are all of equal length, and bear usually a similar, or rather corresponding number of tubercles. The row of large tubercles round the umbilical margin gives to that opening a distinctly coronated aspect, but those on the middle of the sides are sometimes so small as to be barely perceptible. The aperture of the original of fig. 1, on Plate IV., is about three inches and three-fourths wide, by three inches and one line in height.

Seven specimens of this "strongly characterized" species were obtained, most of which are curiously distorted. None of them are very perfect, and yet nearly all of the essential peculiarities of the fossil are well exhibited in one or the other, except the outlines of the septa and the shape of the outer lip.

In the preliminary report previously referred to, Mr. Billings says that the specimens just described are nearly related to *Ammonites Stoliczkanus*, but that they are "perfectly distinct" from it. The difference between the shells from the two localities seems to the writer to be scarcely of specific importance. *A. Stoliczkanus* was originally described from a single half grown example, about three inches and three quarters in diameter. Apart from the circumstance that some of the tubercles originally bore long spines, (a feature seen so rarely even now that there is no wonder that it was not observed before) Mr. Gabb's description of the

Californian shell applies with great exactness to the present specimens, except in one particular. Each rib in the type of *A. Stoliczkanus* is described as bearing six tubercles, three on each side of the periphery, but there are usually nearly double that number in the corresponding costæ of the fossils collected by Mr. Richardson. Although this might appear to be an important difference, it is doubtful whether it is of more than varietal value. The number of tubercles to each rib is variable in actual specimens, and they show a marked tendency to divide into two or three in the course of growth. Thus, in the last whorl but one of the original of Plate IV., fig. 1, there is a single tubercle on the umbilical margin, another on the middle of the sides, and a third trifid one on the edge of the periphery. The description of the tuberculation of the type agrees so well with some of the Queen Charlotte Island specimens, that the latter are, (for the present at least) regarded as simply a variety of *A. Stoliczkanus* with rather more numerous tubercles than usual, to each rib.

Pictet's group Mammillati, in which this species is placed, differs from the Rotomagenses chiefly in the absence of tubercles or carination on the periphery of the shell. It is partly made up of Ammonites taken from that division and from the Dentati. *A. laticlavius* of Sharpe, from the Grey Chalk of the Isle of Wight, bears a considerable resemblance to this shell, but the whorls of the English fossil are flatter, and its aperture is much higher than wide.

### *Group III.—Macrocephali, Von Buch.*

SUBGENUS STEPHANOCERAS, WAAGEN (PARS.)—"Geognostich Palæontologische Beitrage," von Dr. E. W. Benecke, Munchen, 1869. Vol. II., page 248.

AMMONITES LOGANIANUS. (N. Sp.)

Type. Plate VIII., fig 2.

Shell compressed, but rather thick; inner whorls entirely covered, except about three-fourths of the last one;* umbilicus of medium size.

The early volutions are apparently very strongly involute, but the two outer ones are much more loosely coiled. The last whorl is obliquely compressed at the sides, which are widest just before they

* In the only two specimens obtained, the centre was covered by the matrix and it is just possible that if this were removed, rather more than one volution and three-fourths of another would be visible externally. Still, the shale was detached from the umbilicus of the example figured, to a depth of nearly three-quarters of an inch, without a trace of the inner whorls being exposed.

commence to descend towards the sutures; the periphery is rounded but slightly flattened. The aperture is subovate, its base being con-

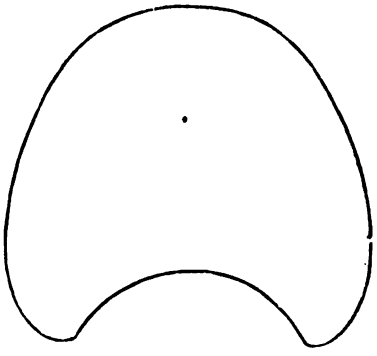

Fig. 3.

Fig. 3.—A. Loganianus, outline of the aperture of a typical specimen.

cavely emarginate. If measured in the centre, where the emargination is greatest, the height of the aperture is rather less than its width, but as viewed externally the height and width of the whorls are nearly equal.

The umbilicus of the most perfect specimen is rather less than one-third of the entire diameter; its inner face is somewhat straight and precipitous below; its outer margin is evenly rounded. It is deeply excavated in the centre of the shell, but becomes shallower very rapidly towards the mouth.

The surface ornamentation consists of primary, trifurcating ribs, which usually alternate with secondary, simple and shorter ones. Commencing at the sutures, the primaries are at first distant, obtuse and prominent; then at about a third of the distance across the sides, they trifurcate and pass over the periphery, reuniting at exactly similar points. The points where the primaries begin to trifurcate are marked by small elevations, or tubercles.* The intervening costæ are simple and do not extend to the sutures, but become obsolete near the middle of the sides. Sometimes the secondary ribs are absent, and there is rarely more than one between each pair of primaries. Although much worn in the actual specimens, there is reason to suppose that all the costæ were originally acute; the grooves between them are concave, and a little wider than the

* In one specimen, these are narrow and elongated; in the other, whose surface is much abraded, they are rounded and obtuse; in both they are feebly marked and inconspicuous.

ribs. As viewed along the siphonal edge, the whole of the costation is rather fine in proportion to the size of the shell; near the aperture, the greatest distance between the summits of two contiguous ribs (on the periphery) rarely amounts to as much as two lines, the average being about a line and a-quarter.

The specimen figured, which although in some respects the most perfect of the two, is very much distorted, measures about five inches in its greatest diameter, the width of its umbilicus being about eighteen lines. The other is four inches and two lines across, and its umbilical cavity is fifteen lines wide.

### A. Loganianus (?) Form A.

Plate IV., figs. 2, 2*a*.

Shell subglobose; inner whorls entirely covered except the outer half of the last one; umbilicus rather small.

Outer whorl somewhat inflated, broadly rounded on the periphery, and slightly compressed at the sides. Umbilical cavity rather more than one-fourth of the entire diameter, deep in the centre and shallow exteriorly. Margin of the umbilicus rounded, its inner face steep but low. Behind the mouth of the shell there is a broad and moderately deep groove or constriction, and the whorl contracts very perceptibly at a short distance from the aperture. Near the sutures there is a shallow sinus on each side of the lip, which is produced into a broadly rounded process on the periphery. The groove behind the mouth seems to follow the contour of the outer lip, unless the latter once bore lateral lobes, of which there is no evidence. The aperture is transversely arcuate, its breadth being nearly three times as great as its height. In the middle of the same whorl, before it begins to narrow, the height of the volution is much greater in proportion to the width.

The sculpture consists for the most part of primary ribs, which rise from the sutures, and bifurcate at about a third of the distance across the sides, before passing over the periphery. About eighteen of these can be counted on the outer whorl. The points of bifurcation are not marked by any distinct swellings or tubercles. Occasionally a simple and shorter rib intervenes between a pair of primaries, but the intermediate ribs are often wanting altogether, and when present never reach to the sutures. At first the costation is comparatively close set and the ribs, with their corresponding grooves, are subangular, but in the last half turn they get wider apart and more rounded. The whole sculpture is very coarse

for the size of the shell; in the only specimen of this variety, whose greatest diameter does not much exceed two inches, the ribs are as wide apart as they are in the largest example of the typical form, which is at least four times its size.

Septation unknown.

The exact dimensions of the fossils are as follows: Greatest diameter two inches and nearly four lines; width of umbilicus, about eight lines; height of aperture, five lines; breadth of do., one inch and three lines.

### Ammonites Loganianus (?) Form B.

**Plate VIII., figs. 1 and 1*a*.**

Shell inflated, globose; the early volutions entirely concealed; umbilicus very small.

In the only specimen collected, the outer half of the last whorl is much distorted, and compressed in such a way that the sides are partly forced over the umbilical opening. For this reason the exact amount of the involution, the proportionate width of the umbilicus, and the shape of the aperture cannot be very accurately ascertained. Curiously enough, the distortion does not seem to have much affected the rest of the shell.

Only one whorl is visible externally; this is ventricose alike on the siphonal edge and at the sides; its inward curve is also convex, but rather abruptly so near the sutures. Where the distortion is least, the maximum width of the whorl (or thickness of the shell) is nearly equal to three-fourths of the greatest diameter. The aperture is obviously much wider than high, though it is difficult to estimate in what proportion. The umbilicus is very small and deep.

The surface is ornamented with primary, bifurcating costæ, and intervening, secondary, simple ribs. About thirty of the former can be counted on the last volution. They commence at the sutures, bifurcate at about a third of the distance across the sides, and reunite at exactly similar and opposite points. There are no swellings or tubercles on the ribs where they begin to divide. At the commencement of the last whorl the ribs bifurcate at a comparatively short distance from the sutures, but near the aperture this distance is much increased. The secondary costæ usually alternate with the primaries, but the former are often absent; when present they encircle the periphery but do not extend to the sutures. Two bifurcating ribs are occasionally placed together without any intervening one; or two simple costæ may occur be-

tween a pair of primaries. When the latter is the case, one of the intervening ribs is unusually long and almost joins one of the primaries, so that a tendency to bifurcation is then observable. The whole of the ribs are at first crowded and fine (except near the sutures) but at a little distance from the aperture they get much wider apart. They are prominent, regular and acute (though sometimes, under the lens, they appear a little rounded at their summits), and the grooves between them are rather deeply concave. In the earlier part of the outer whorl, the grooves are a little wider than the ribs which bound them, they (the grooves) gradually increase in width, until, near the aperture, they are about three times as wide and much shallower in proportion than at the commencement of the volution. The ribs, too, are more acute and prominent near the outer termination of the shell.

Septation unknown.

Where the specimen is least distorted the greatest diameter is about two inches, and the maximum width of the whorl (or thickness of the shell) is nearly one inch and a half.

It is doubtful whether the four Ammonites described above should be regarded as different stages of growth of one shell, or as two, or even three, distinct species. Form A. and form B. are each represented by a single specimen of about the same size. Notwithstanding its globose shape, and the much greater involution of its whorls, it is easy to understand that Form B. may be the young of the type of *A. Loganianus*, as there is little essential difference in the style of costation of both. The sculpture of Form A. is certainly coarser and its ribs are much more distant than is the case in any of the other three specimens; the costæ also appear to be more obtuse and angular, but as the surface is much waterworn, it is not safe to attach any importance to the latter character. In Form A. one volution and a half are visible externally, and in Form B. only one can be seen, but this difference may have resulted from the peculiar distortion to which the last named specimen has been subjected. On the whole, it is most probable that these four Ammonites belong to one species, of which Form A. may constitute a well marked variety.

In many respects, *Ammonites Loganianus* is nearly allied to the *A. Gervillei* of Sowerby. Form B., in particular, can scarcely be distinguished from the shell figured by D'Orbigny,* as the young state of *A. Gervillei*. In more fully grown specimens, the differences between the two species are obvious; *A. Gervillei* is then much the most globose shell of the two, and

* "Paléontologie Française. Terrains Jurassiques." Vol. II. Atlas, Plate CXL.

has one more whorl visible externally. The volutions of *A. Loganianus* are coiled in a very similar manner to those of *A. bullatus*, D'Orbigny,* but the sculpture and shape of each are perfectly distinct.

The Oolitic Macrocephali, as a whole, are said to possess a combination of characters by which they can generally be distinguished from Cretaceous Ammonites of the same group. In the Oolitic species the shell is more globose, the whorls are very strongly involute, and, as Stoliczka has pointed out, "the lateral ribs form a tubercle about the middle of the sides, and then divide into two or more ribs." In each of these respects, *A. Loganianus* has more the aspect of an Oolitic than of a Cretaceous species.

The name proposed for this shell is intended as a tribute, of respect and affection, to the memory of the late Sir W. E. Logan.

### *Group IV.—Coronarii, Buch.*

SUB-GENUS STEPHANOCERAS, WAAGEN (PARS.)—"Geognostich-Palæontologische Beitrage." Munchen, 1869. Vol. II., page 248.)

#### AMMONITES RICHARDSONII. (N. SP.)

Plate V. Both figures.

Shell thick, inflated; umbilicus wide and deep, conspicuously coronated round its inner margin by a row of distant, rounded tubercles.

Volutions about six, very closely and tightly coiled, so that their width is about two-thirds greater than their height, much raised at the sides, widest and sub-angular near their middle. The amount of involution is always slight, and decreases exteriorly; the inner faces of the early volutions, and the whole of the sides of the last but one being fully exposed. In the outer whorl the periphery is ventricose and rounded; its curve is confluent with that of the outer half of the sides, which swell up (almost concavely) so as to form a sub-angular ridge about their middle, but nearer to the sutures. From the summit of this ridge, which forms the outer margin of the umbilicus, the whorls slope abruptly and almost precipitously down to the sutures, so as to present a nearly straight (though slightly convex) umbilical face. In the last half turn the umbilical margin becomes more rounded, and the inner face of the whorl is more oblique and spreading. As the greater part of one side of the only specimen collected is worn away, the exact width or thickness of the shell cannot be ascertained, but it was probably more than one-

* "Paléontologie Française. Terrains Jurassiques." Vol. II. Atlas, Plate CXLII., figs. 1 and 2.

half of the entire diameter. The umbilicus is deeply excavated and concavely conical, especially in the centre, but it gets shallower and loses its regularly conical shape near the aperture. As compared with the outer whorl, the inner volutions occupy rather less than one-half the greatest diameter of the shell. As measured from two opposite tubercles, the umbilicus is equal to nearly three-fourths of the whole diameter.

The aperture is transversely arcuate, and its sides are truncate and subangular.

The last whorl is ornamented with fourteen, distant, raised, rounded tubercles, which encircle the umbilicus. About as many can be counted on the volution which precedes it, and the coronations can be traced even in the earlier whorls. Where the test is preserved, the periphery and part of the sides are covered with close-set, numerous and transverse ribs, (varying from a quarter of a line to a line in width) which are too fine to leave definite impressions on the cast. These appear to proceed from each of the tubercles in bundles of about ten or fourteen. The distance from the centre of two contiguous tubercles on the outer whorl was found to be about seven lines, and in a space of equal width immediately below them, fifteen or sixteen ribs could be counted. These, however, are very unequal in width, even over a very small area, and, of course, are widest near the mouth.

Greatest diameter of the shell, four inches and five lines; extreme width of umbilicus, from the centre of two opposite tubercles, three inches and one line; of the inner whorls, (from suture to suture) two inches and one line. The breadth of the aperture is roughly estimated at two inches and nine lines in its widest part; its height is about eleven lines.

This interesting shell, of which only one imperfect specimen was collected, is nearly related to the *Ammonites coronatus** of Bruguiere, and *A. Blagdeni*† of Sowerby. The extreme fineness of the ribs in *A. Richardsonii*, together with the very slight involution of its outer whorl, will enable it to be distinguished from either at a glance.

It affords the writer much pleasure to be able to associate the name of its discoverer with this beautiful species. The collection of which it forms a part is only one out of the many additions which Mr. Richardson has made to our knowledge of the geology and palæontology of Canada, in a period extending over thirty years.

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* Paléontologie Française, Terrains Jurassiques. Vol. I. Atlas. Plates CLXVIII. & CLXIX.

† "Mineral Conchology." Vol. II., page 231. Plate CCI.

*Group V. Planulati, Waagen, non Buch. (Coronarii, Buch. et auctorum, pars.)*

SUBGENUS PERISPHINCTES, WAAGEN.—"Geognostich-Palæontologische Beitrage," von Dr. E. W. Benecke. Munchen: 1869. Band 2, p. 248.

AMMONITES SKIDEGATENSIS. (N. SP.)

**Plate VII. Adult and type. Plate IX., figure 1: An immature, but perfect specimen, supposed to belong to the same species.**

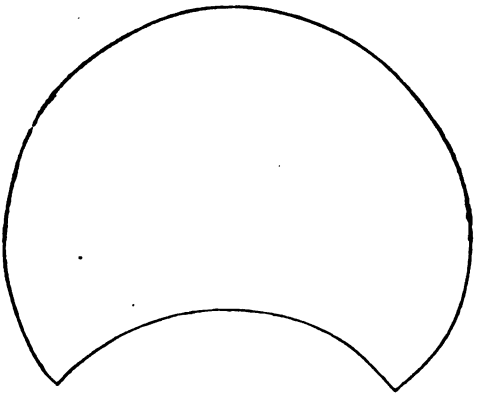

FIG. 4.

FIG. 4.—*A. Skidegatensis.*—Outline of aperture of the specimen represented at Plate VII.

Shell composed of many rounded whorls; umbilicus much more than half the entire diameter; surface regularly costate; ribs acute and separated by broad convex grooves, alternately bifurcating and simple. Volutions sharply coronated above and below.

The sides of the inner whorls are fully exposed; the umbilicus is accordingly very wide, it is also rather shallow externally, but is much deeper (apparently) near the centre. Measuring from suture to suture, the inner whorls (collectively) make up rather more than half of the entire diameter. Only the two outer volutions are visible in the largest specimen, the rest being covered by hard and tenacious shale, which could not be removed except at the risk of spoiling the fossil. As seen transversely, the outer whorl is raised at the sides, and slightly compressed at the periphery. Its base is shallowly and concavely emarginate by the encroachment of the preceding volution. The aperture is about one-third wider than high; its greatest breadth being a little below the middle.

The sculpture consists of transverse raised ribs, which although acute and prominent, are always narrower than the deeply concave and rounded grooves which separate them. What may be conveniently termed the primary ribs, commence at the sutures, bifurcate about the middle of the sides, pass over the periphery, and reunite at a corresponding point on the other plane of the shell. From thirty-five to thirty-six of these primary costæ can be counted on the last volution. At the point where they begin to bifurcate, they swell up into narrow and transversely elongated elevations, which can scarcely be termed tubercles, at least if that term is used solely to convey the idea of circular prominences. Sometimes, especially near the aperture, the bifurcation of the primaries is obscure, and the appearance then presented is that of pairs of continuous ribs, separated by one or two shorter ones. Occasionally, also, two bifurcating and primary costæ immediately succeed each other, without the intervention of any secondary rib. The secondary costæ are invariably simple, as well as being always shorter than the primaries. They encircle the outer half of the whorls only, and do not extend to the sutures, but become obsolete and disappear about the middle of the sides, just where the primaries begin to bifurcate. In the last whorl but one the arrangement of the costæ is very uniform; a single bifurcating rib almost invariably alternating with a shorter, simple one; but near the aperture the grouping is much more variable and irregular. As seen along the periphery, the whole of the ribs are both equidistant and of the same height; they are not separated by a narrow space which encircles the siphonal edge, (as is the case in some nearly allied species,) but pass uninterruptedly over it.

Septation unknown.

The greatest diameter of the largest known specimen, (to which the above description refers exclusively, and which must be regarded as the type of the species), is seven inches and two lines; the width of the umbilicus, from suture to suture, is about three inche and eight lines.

Besides the specimen just described, there are six small Ammonites which most probably belong to the same species, although the intermediate stages of growth have not yet been observed. The most perfect of these, which measures about two inches and three lines across, will be found represented at figure I. of Plate IX. The others are mostly mere fragments, but they show that the sculpture is very variable in different individuals of the same size, besides giving other information which happens not to be afforded by more perfect individuals. As compared with the type, the fossil figured on Plate IX. has its outer whorl proportio-

nately more raised at the sides and more compressed on the periphery, The inner faces of the whorl are more oblique and not so evenly rounded, and the umbilicus is rather less than half the entire diameter. These differences, however, may be partly due to the distortion which the small specimen has undergone; compression having been effected in a direction at a right angle to the sides. The umbilical cavity is concavely and rather deeply excavated in the centre, but it gets shallower rapidly as the shell increases in size. In this specimen there are not less than six volutions, and perhaps as many as seven. The costation, in this particular instance, is remarkably coarse for the size of the shell, and the intermediate secondary ribs are almost, if not altogether, absent. On the outer whorl there are twenty-four ribs, each of which proceeds from the sutures, and bifurcates about the middle of the sides. After bifurcating on one side of the shell, the ribs pass over the periphery, and re-unite (in this instance at least) at directly opposite and corresponding points, on the other. The linear elevations which arise at the points where the ribs bifurcate, are unusually prominent and give the shell a much more decidedly coronated aspect than it bears when it has attained to nearly its full size. Two out of these six small specimens shew a coarse style of ribbing, the ribs being exceptionally prominent and wide apart. Such individuals can scarcely be distinguished from the fossil figured by D'Orbigny in the "Paléontologie Française" * as the *Ammonites Braikenridgii* of Sowerby.† In that species the raised protuberances which arise where the ribs bifurcate, alternate with each other across the siphonal edge, instead of being placed at points immediately opposite, but an alternate grouping may also be traced obscurely in some of the Queen Charlotte Island specimens.

In the four remaining, the ribs, as they arise from the sutures, are as wide apart as in the others, but they either trifurcate before passing over the periphery, or else a single secondary rib alternates with each of the bifurcating primaries. Along the siphonal edge, therefore, the ribs in this variety are much more numerous and closer together than they are in the other.

In all the specimens, whether large or small, the sculpture is remarkably similar. The ribs are invariably acute, they are separated by concave grooves which are much wider than the costæ themselves, and the

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* "Terrains Jurassiques." Vol. II. Atlas, Plate CXXXV, figs. 3–5.

† The original description and figure *A. Braikenridgii* in the "Mineral Conchology," are so vague and unsatisfactory that it is by no means improbable that this name may have been bestowed by European writers on two very different species. Further, the shell represented by Pictet, in his "Traite de Paléontologie" (Atlas, Plate LV., fig. 1) as *Ammonites Humphreysianus*, seems to be identical with the *A. Braikenridgii* of D'Orbigny.

shape of the elevations which give a more or less coronated aspect to the shell, varies very little in different examples. Assuming that the whole of these seven Ammonites belong to one species, it was at first thought difficult to account for the fact that the width (or thickness) of the outer whorl in small individuals was so much greater in proportion to their entire diameter than is the case in more fully grown shells. The explanation of this circumstance is very simple. In a specimen at a comparatively early stage of growth, the whorls are so much compressed on the periphery and raised at the sides that the width of the aperture may be twice or even three times as great as its height. When more nearly arrived at maturity, the whorls become rounded and their sides compressed, the height of the aperture become nearly equal to its breath, and the result is a great addition to the diameter of the shell, which is not accompanied by a corresponding and proportionate increase of its thickness.

An appropriate illustration of this peculiar mode of growth is afforded by the *Ammonites anceps* of Reinecke, as figured by D'Orbigny in the "Paléontologie Française." In the Atlas to Vol. II. of the "Terrains Jurassiques," Plate CLXVI., figures are given of two specimens of *A. anceps*, one of which is represented as one inch and five lines, and the other as three inches and four lines in diameter. The smallest of these fossils is the thickest of the two, at least if the figures are correct.

Mr. Billings has suggested * that the large specimen which is here regarded as the type of *A. Skidegatensis*, is closely allied to the *Perisphinctes tyrannus* of Neumayr,† from the "Macrocephalen Kalken" of Brielthal. The two species certainly resemble each other in general shape and in the amount of involution of the whorls, but their sculpture is sufficiently distinct. The outer whorl of *P. tyrannus* is said to be ornamented with nineteen distant primary ribs, which trifurcate in passing over the siphonal edge. In *A. Skidegatensis* the ribs are much more numerous, acute and regular.

*Ammonites anceps* of Reinecke, which also belongs to Waagen's sub-genus *Perisphinctes*, is still more nearly allied to the present species both in shape and sculpture. The only important difference between them is that in the former the ribs are separated by a narrow space which encircles the periphery, and this is never the case in *A. Skidegatensis*.

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* "Geological Survey of Canada. Report of Progress for 1872-73." Page 72.

† "Jahrbuch der Kaiserlich-Koniglichen Geologischen Reichsanstalt." Vienna: 1870. Vol. XX., page 150, Plate IX.

## Ammonites Carlottensis (N. Sp.)

Plate VI.

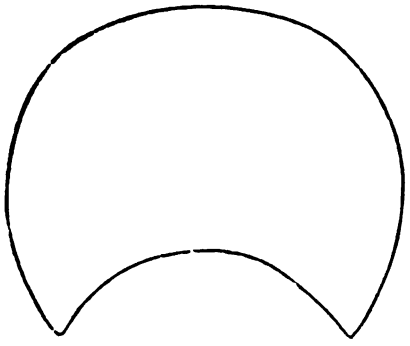

Fig. 5.

Fig. 5.—Outline of aperture of *A. Carlottensis*, as viewed transversely.

Shell composed of (apparently rather few) rounded whorls; umbilicus less than one-half the entire diameter. Volutions encircled by faint, though broad, obtusely rounded or subangular ribs, which are alternately bifurcating and simple. Sides bluntly coronated.

In the only specimen collected, the inner whorls are either covered by the matrix or are wanting altogether. The fossil also has been distorted in such a way as to present nearly an oval shape when viewed laterally, so that the proportion of the umbilicus to the entire diameter varies according to the direction in which it is measured. The same distortion seems to have affected the shape of the outer whorl; at any rate, near the aperture it is compressed both at the sides and on the periphery, while the other half of the same whorl is inflated, the periphery is evenly rounded, though perhaps a little flattened, and the sides are very much raised. As the inner edge of the whorls is usually rounded, there is no distinct margin to the umbilicus; in some places, however, the umbilical face of the whorls is steep, but it is never angular above. Measuring from suture to suture (of the outer whorl) the inner volutions occupy between one-third and one-half of the diameter of the shell. The aperture is always much wider than high; the emargination at its base (caused by the encroachment of the preceding whorl) being moderately deep, or at least, not very shallow.

The outer whorl is ornamented by nineteen primary ribs; these commence at the sutures, and swell out gradually into obtuse, elongated, but more or less rounded tubercles about the middle or near the inner half of

each side, after which they bifurcate widely, but very indistinctly, before passing over the periphery. In the earliest part of the whorl, two simple, secondary ribs, which do not quite reach to the sutures, usually intervene between each pair of primaries. Near the aperture the secondary costæ disappear, and the ribs as they pass over the siphonal edge become much more distant. As viewed along the periphery, the whole of the ribs are about equidistant, the intermediate ones being as broad and as wide apart as the bifurcations of the primaries. The entire costation is peculiar in another way; the ribs, though wide, are obtuse and not much elevated, and the corresponding depressions, though broad, are always very shallow. At some distance from the aperture, where the test is preserved, both ribs and grooves are obtusely angular. Near the outer edge of the volution they become more obsolete as well as wider, and probably with age disappear altogether.

Septation unknown.

Greatest diameter of the shell, five inches and ten lines; maximum width of umbilicus, (from suture to suture) two inches and five lines. Height of aperture, one inch and three and a half lines; greatest breadth of do., twenty-three lines.

The above description refers exclusively to the solitary and imperfect specimen collected by Mr. Richardson, which is represented at Plate VI. Although only partially characterized at present, the species seem to possess sufficiently distinctive features to entitle it to the new name which is here proposed for it. The sculpture of *A. Carlottensis* is not very dissimilar to that of *A.* (Perisphinctes) *tyrannus*, but the shape of the two shells is quite different. In *A. Carlottensis* the umbilicus is comparatively small, in *A. tyrannus* it is very wide. In the former, when undistorted, the inner whorls together would probably occupy about one-third of the entire diameter; in the latter they would make up more than half. *A. Skidegatensis* resembles *A. tyrannus* in shape but not in sculpture, while *A. Carlottensis* is allied to *A. tyrannus* in sculpture but not in shape.

### Ammonites Lapérousianus. (N. Sp.)

**Plate III., figure 3.**

Shell composed of many rounded but slightly compressed whorls; umbilicus about one-half of the entire diameter; surface marked by simple, transverse ribs, and by numerous, oblique, periodic constrictions

Volutions about six, increasing slowly in size, the sides of the inner whorls being almost completely exposed; outer whorl nearly circular, but a little compressed at the sides, its base being shallowly emarginate by the preceding volution; aperture slightly wider than high.

Surface ornamented with simple, transverse, flexuous ribs, and oblique, periodic grooves or constrictions. As the direction of the constrictions is different to that of the ribs, some of the latter are almost always truncated by the former. In the outer whorl of the specimen figured, there are nine or ten constrictions, each of which is narrow on the periphery and wide on the inner half, at least, of the sides. They divide the ribs into sets in a somewhat uniform way. Near the aperture there are generally six ribs between each pair of grooves. Of these, the first three are continuous, as is also the sixth, or outer one, which is so oblique as to truncate about one-half of the fifth, near the middle of the sides, and the base of the fourth, near the sutures. Or, it might be said with equal propriety, that the outer rib trifurcates at unequal distances, before passing over the periphery. In each set of ribs, the two outer ones form part of the boundaries of the grooves by which they are separated. Both ribs and constrictions become faint and nearly obsolete on the periphery, especially the former. The constrictions are obviously the remains of former lips, which were sinuous at the sides, and produced into narrowly rounded, or spout-like processes, on the siphonal edge of the shell.

Septation unknown.

Greatest diameter of the largest example, nineteen lines; width of umbilicus, from suture to suture, not quite nine lines.

The description applies solely to the specimen figured, which is the largest of the only two collected. The other one, which measures scarcely an inch across, is comparatively flat and thin, its aperture is much higher than wide, and the ribs and constrictions are not so clearly defined as they become at a more advanced stage of growth.

There is a considerable resemblance between these shells, which are obviously very immature, and the *A. Seranonis* of D'Orbigny,* a French Lower Neocomian fossil. D'Orbigny's species is represented as having a thinner and flatter shell than is that of *A. Laperousianus* at the same age. Young specimens of the latter are indeed nearly as flat as the French fossil, but the umbilicus of the smallest of the two individuals

* "Paléontologie Française. Terrains Cretaces." Vol. I., page 361, Atlas, Plate CIX;, figs. 4 and 5.

from the Queen Charlotte Islands is then comparatively small. In the outer whorl of *A. Laperousianus* there are nine or ten oblique grooves or constrictions, in that of *A. Seranonis* there are only four.

Septation unknown.

Inscribed to the memory of the gallant Commander of the *Astrolabe*, who visited these islands in 1786.

*A. Laperousianus* probably belongs to Dr. Waagen's sub-genus Perisphinctes, the young shells of which are said to be marked by periodical constrictions. Other writers regard these marks of arrests of growth as one of the distinguishing features of the *Ligati*, and the species is evidently one of the connecting links between that group and the *Planulati*. Its full characters have yet to be ascertained.

### *Group* 6. *Ligati, D'Orbigny.*

#### Ammonites Timotheanus, Mayor.

Plate III., figures 2, 2*a*.

*A. Timotheanus*, Mayor. Pictet et Roux. "Mollusques des Gres Verts," page 39. Plate II., fig. 6, and Plate III., figs. 1, 2. Stoliczka, "Cretaceous Cephalopoda of Southern India." Series 3, parts 6-9, pages 146, 147, Plate LXXIII., figures 3 to 6.

Shell composed of rather closely involute, nearly square whorls, which become rounded with age; umbilicus about one-third the entire diameter; surface almost smooth, but marked by distant, periodic constrictions.

As far as can be ascertained from the rather imperfect specimens, about one-fourth of the inner whorls is exposed. In two of these, whose diameter is less than as many inches, the periphery of the outer whorl is flattened, the sides are obliquely compressed, and the umbilical faces are straight and steep. The squareness of the whorls is very marked at this stage of growth, but the outer angles are more rounded than the inner ones. Their aperture is subquadrangular, and wider than high, even if the basal emargination (which is squarish and moderately deep) is not taken into account. The proportions of the umbilical opening are best seen in these half grown shells. In an individual whose greatest diameter is fourteen lines, the width of the umbilicus is five lines; its margin is bluntly angular. A larger but less perfect specimen, which measures nearly three inches and a-half across, has nearly circular whorls, but they are still a little compressed at the sides. Its aperture is ovately orbicular, but widest

below, and the basal emargination is rather deeply concave. If measured outside of the emargination, the height of the aperture is rather greater than the width; if in the centre, the width slightly exceeds the length. In other words, the lateral compression of the whorls is so little, that it is not equal to the depth of the emargination. In the adult shell, the umbilical margin is evenly rounded.

The sculpture consists for the most part of obliquely transverse distant, periodic furrows or constrictions. About six of these can be counted in the outer whorl of each of the specimens; they are directed obliquely forwards on the sides, and then bend backwards so as to form a series of shallowly concave sinuses on the periphery. Besides these, there are a few faint revolving lines on the siphonal edge, and some still fainter striæ of growth across the whorls, but both are so inconspicuous that, apart from the narrowly concave constrictions, the surface is practically smooth.

Septation unknown.

The three Ammonites described above agree so exactly with Stoliczka's description and figures of *A. Timotheanus*, that they are provisionally (at least) regarded as belonging to that species. In the absence of any definite knowledge of the septation of the Queen Charlotte Island specimens, their identification is, of course, somewhat uncertain. The memoir in which *A. Timotheanus* was first described is, unfortunately, inaccessible to the writer. According to Stoliczka, Pictet originally recorded it as a fossil of the "Gres Verts" of Saxonet in Savoy. It was afterwards noticed by D'Orbigny, Gras and others, from the Gault and Etage Albien (Lower Chalk) of the South of France. Hauer thinks that specimens of an Ammonite from the Gault of South-Western Hungary may belong to this species. In India, *A. Timotheanus* has been collected from the "Trinchinopoly Series of Serdamungalum, North of Anapaudy and near Ondoor;" also from the "Ootatoor Series of the neighbourhood of Odium: Mooraviatoor and Penangoor." It was first catalogued as a British fossil in 1875. In the Quarterly Journal of the Geological Society of London (Vol. XXXI., pp. 277 and 306), Mr. A. A. Jukes Brown says that it is found, though rarely, in the phosphatic deposits of the Upper Gault, or "Etage Vraconnien," at Cambridge.

*Group 7.—Fimbriati, D'Orbigny.*

*Sub-genus Lytoceras, Suess.* (*Thysanoceras, Hyatt.*)

AMMONITES FILICINCTUS (N. SP.)

Plate II., Figs. 2, 2*a*, 2*b*, 2*c*, and 3.

Shell composed of many, slightly involute whorls, which are nearly circular in section when half grown, but which become a little compressed laterally with age. Surface ornamented with minute, crowded, transverse, raised lines, and with numerous periodic furrows or constrictions.

Whorls about six or seven, two-thirds or more of the inner ones being exposed. In a specimen (Plate II., fig. 2) which measures about an inch and a quarter in diameter, the outer whorl is rounded, but compressed slightly and obliquely at the sides, while the downward and inward curve towards the sutures is abrupt and sub-convex. At this stage of growth the aperture is broader than high; its outline is almost circular, but the base is shallowly emarginate. In a fragment of a much larger and undistorted specimen, the oblique flattening of the sides is more decided, and the outline of the aperture is rather more elliptical.

The true proportions of the umbilical opening can be seen only in the small specimen represented at Plate II., fig. 2, the others are either imperfect or crushed out of shape. In this individual, the width of the umbilicus (the margin of which is rounded and indefinite) is not quite half of the entire diameter.

The whole surface of the test is encircled by fine, transverse, thread-like striæ or raised lines, which are scarcely visible to the naked eye and give to the shell a silky lustre. The striæ are nearly straight on the periphery, but flexuous on the sides and inner margins of the whorls. They are parallel, simple, and nearly equidistant; never either crenate or bifurcating. Besides the striæ, the whorls are girdled by periodic, transverse furrows or constrictions, which occur at irregular and sometimes distant intervals, in half-grown shells. In the outer whorl of large specimens, these furrows become more numerous and regularly disposed, so that when viewed at a little distance, the sculpture near the mouth seems to consist of broad flattened ribs, separated by deep, though comparatively narrow, grooves. It requires a closer inspection to detect the thread-like striæ on the surface of each rib, but although they (the

striæ) are sometimes obliterated on the cast, they are always clearly defined when the shell is preserved. In the last whorl of a large but distorted specimen, seventeen of these rib-like spaces can be counted, which average about a quarter of an inch in width, the grooves being about half as wide. It is scarcely correct to call the spaces between the grooves ribs, for, although the furrows sink deeply below the general level of the surface of the shell, there are no corresponding elevations above it. Sometimes the spaces are as much as half an inch wide.

The outlines of the septa can only be traced in a half-grown specimen (the original of Plate II., fig. 2) and in it they are partly covered by the shell. The siphonal ("dorsal") saddle is small, *simply conical and entire*. Its sides are slightly convex, but they are not toothed or cut. There are two bipartite lateral lobes and saddles, with bifid terminations, on each side. The first lateral lobe, which is the largest, is about as long as the siphonal one. The number of accessory lobes and saddles between the umbilical margin and the sutures of the whorls cannot be made out very satisfactorily, but as the second lateral lobe is placed on the edge of the umbilicus, they must be very few.

Five specimens of this species were collected, three of which are either imperfect or much distorted.

These shells agree exactly, both in shape and sculpture, with the figures and descriptions of *Ammonites Sacya*, Forbes, as given in the "Palæontologia Indica." Stoliczka's illustration of the type of *A. Buddha*, Forbes, (a synonym of *A. Sacya*) would serve as a portrait of the specimen represented at Plate II., fig. 3. Yet the septation of the two species is not alike, the principal difference being in the shape of their siphonal saddles. Those of *A. Sacya* are said to be tongue-shaped and toothed, ("sella siphonali denticulata, linguiforme") while those of *A. filicinctus* are conical and entire.

*A. filicinctus* is also nearly allied to *A. quadrisulcatus*, D'Orbigny, especially in the outlines of its septation, the siphonal saddles being of the same shape in each. *A. quadrisulcatus* was at first imperfectly described (in the "Paléontologie Française") from half-grown casts. It has since been illustrated rather copiously by Zittel, in the "Cephalopoden der Stramberger Schichten," also in the "Fauna der Aelteren Cephalopoden Fuehrenden Tithonbildungen," and Tietze has figured a variety of it in the "Jahrbuch der Kaiserlich-Koniglichen Geologischen Reichsanstalt" of Vienna, Vol. XXII., (1872) Plate IX., figs. 12*a* and 12*b*. In Zittel's diagnosis of *A. quadrisulcatus* no mention is made of any transverse striæ, although some rather distant ones are represented in his

figures. On the other hand, close, thread-like striæ, similar to those which are so characteristic of *A. filicinctus*, are shown in Tietze's illustrations of *A. quadrisulcatus*, although nothing is said about them in the text. Zittel says there are never more than four transverse grooves to each whorl of *A. quadrisulcatus*, but Tietze figures a variety with five. In a large though distorted specimen of *A. filicinctus*, there are at least sixteen grooves or constrictions on the outer whorl, in the inner ones even they are often very numerous. By this latter character *A. filicinctus* may be readily distinguished from D'Orbigny's species.

The aperture of the original of Plate II., figs. 2*a* and 2*b*, presents an appearance which gave rise to a curious mistake. It is almost filled with small white crystals of calcite, but in the centre of the inner margin of the whorl there is a dark coloured ring, (like the rough end of a tube) and this was at first thought to be the siphuncle. On making a transverse section of the shell, at nearly a right angle to the mouth, a similar appearance was seen in one part of the surface exposed. On a careful re-examination of the specimen with a lens, traces of the true siphuncle were found in the ordinary position on the periphery, and the illusive nature of the other was then apparent. It would have been superfluous to mention this circumstance, but as figure 2*b* (on Plate II.) might otherwise mislead, it is as well to state that it was intended to represent the appearance presented by a section of the original of figure 2, with special reference to the position of the supposed siphuncle. In this figure, what seem to be the outlines of the inner whorls, as well as the presumed siphuncle, (which by accident is placed a little too high up) are caused by adventitious matter in the interior of the shell.

### Ammonites Crenocostatus. (Provisional name.)

Plate IX., figs. 2, 2*a*.

(Perhaps a half-grown specimen of *A.* (Lytoceras) *Liebigi*, Oppel.
Compare Zittel's Cephalopoden der Stramberger Schichten," especially Plate IX., figures 6*a*, 6*b* and 6*c*.)

Shell composed of many loosely coiled, and scarcely involute, rounded whorls, whose convex surface is encircled by numerous fine, transverse and minutely crenate raised lines.

Volutions about five or six, nearly circular in outline, but a little compressed at the sides, and then sloping rather suddenly inwards and downwards to the sutures, which are very deeply excavated; periphery

rounded. The amount of involution is very small indeed, and the inner whorls are well exposed. They occupy a space about equal to one-half of the entire diameter. The aperture is ovately orbicular, except at the base which is very slightly emarginate; its height and breadth are nearly equal.

The sculpture characteristic of the species is best seen in the last half turn. It consists of transverse, raised lines, which are found to be minutely crenate when examined with a lens. They are placed at irregular intervals (of from one-sixth to one-eighth of an inch in width,) upon the convex surface of the shell, and are not separated by any corresponding grooves or depressions. Near the aperture there are a few indistinct, but rather crowded revolving lines on the periphery and outer half of the sides. A few faint transverse grooves, or constrictions, (the remains of former lips) also cross the whorls at irregular but distant intervals. Four of these can be counted on the last volution.

The septa form three lobes on each side, of which the two outer ones at least are very deeply and somewhat numerously divided; the second lateral lobe is placed on (or near) the umbilical border, and a single accessory one on the inner margin of the whorls. The first and second lateral lobes and saddles are bipartite with bifid subdivisions; the dorsal lobe is nearly as long as the first lateral, which is the broadest; the siphonal saddle appears to be elongate-conical, simple and entire; it is about one-half the height of the first lateral; the outer branches of all the saddles are scarcely longer than those of the inner ones.

Greatest diameter, one inch and nine lines; do. of the inner whorls, nine lines; width of the outer whorl rather less than seven lines; height of the same, as measured from the outside, rather more than seven lines.

As there is only one small specimen available for comparison, which does not show the characters of the septation very clearly, it is doubtful whether this shell should be regarded as identical with the *Lytoceras Liebigi* of Oppel, or as a distinct species. So far as figures of the European fossil enable one to judge, there are certainly some differences between the two at the same age, but these are slight and, perhaps, unimportant. In young shells of *L. Liebigi*, the amount of involution of the whorls is greater than is the case with those of the Queen Charlotte Island shell. The surface of the outer whorl of *L. Liebigi* is then marked with three or four transverse raised ridges, which are so prominent as to break the curve of its outline; the few constrictions across the last volution of *L. crenocostatus* are bounded by scarcely perceptible elevations. The latter is also rather the flattest of the two shells. Under all the

circumstances it is deemed advisable to keep the two species separate, at least for the present, and a provisional name has been suggested, accordingly, for the fossil collected by Mr. Richardson.

*Group* 8.—*Doubtful Species.*

AMMONITES (Sp. undt.)

Plate III., figures 4, 4*a*.

Compare A. simplus D'Orbigny.

"Paléontologie Française. Terrains Cretaces." Vol. I., pages 208-9. Atlas, Vol. I., Plate LX., figs. 7—9.

Shell strongly involute, globose, the thickness being about a fifth less than the greatest diameter; umbilicus small but deep; periphery rounded; aperture much wider than high. Surface nearly smooth, marked only by a few lines of growth.

Septation unknown.

Diameter of the only specimen five lines; maximum thickness about four lines; width of umbilicus rather less than one line.

This little shell can scarcely be distinguished from the *A. simplus* of D'Orbigny, as figured and described in the work just quoted. On the other hand, many Ammonites have a globose, nautiliform shell in their very young state, so that this fossil is probably only an early stage of growth of one of the species previously described, though, owing to the want of a series of specimens of all ages, it is at present impossible to say of which.

Not a little difference of opinion exists as to what are the true relations of D'Orbigny's *A. simplus*, which is generally believed to be the young of some other species. D'Orbigny himself has united it with his *A. verrucosus*, a decision in which he has been followed by many palæontologists. Stoliczka disputes the correctness of this view, and with much apparent justice. In the "Index Palæontologicus," (Vol. I., pages 49 and 59.) Bronn places *A. simplus*, though with a note of interrogation, (implying a doubt as to the propriety of the reference) among the synonyms of *A. macrocephalus*, Schlotheim. This suggests the idea that the present shell may be the young of *A. Loganianus*, nobis. Zittel includes *A. simplus* in his genus *Aspidoceras*, and the fossil just described is certainly very like the early stage of Oppel's *A. cyclotum*. As the *Ammonites Stoliczkanus* of Gabb has many of the characters of *Aspidoceras*, this little shell may be the young of it.

### HAMITES (?) (Sp. undt.)

Plate IX., figure 3.

Compare Hamites elegans, D'Orbigny.
"Paléontologie Française. Terrains Cretaces." Vol. I., pages 542 and 543. Atlas, Plate CXXXIII., figs. 1 to 5.

A single fragment of a cephalopodous shell, about an inch in length by four lines in diameter, which is referred to this genus with much doubt.

The specimen is quite straight and does not decrease in width very perceptibly. As viewed transversely, its outline is compressed ovate, the greatest width of the ovoid being across what is presumed (by analogy) to be the siphonal edge.

The surface is marked by transverse but slightly oblique ribs, which are narrower than the shallowly concave grooves which separate them. There are also three pairs of obtusely rounded tubercles on the periphery. The tubercles of each separate pair are very close together on the siphonal edge, being scarcely more than a line apart, but the pairs themselves are placed at distant intervals along the length of the shell. The arrangement is uniformly as follows:—five simple and non-tuberculate ribs encircle the shell obliquely, and between each set of five, two or three ribs intervene, which, together, bear a pair of tubercles. Each of the latter are wide enough to embrace two or three ribs. The distance between two pairs of tubercles is generally about one-third of an inch, measuring from the centre of the summit of each.

This species is placed in the genus *Hamites*, principally on account of the strong resemblance which it bears to the *H. elegans* of D'Orbigny, of which it may prove to be an extreme variety. Still, the Queen Charlotte Island fossil is flatter than *H. elegans*, and seems always to have five uninterrupted ribs between those which bear the tubercles. In D'Orbigny's species there appear to be never more than four, and sometimes only two non-tuberculated ribs in each set.

## GASTEROPODA.

### AMAUROPSIS TENUISTRIATA, (N. Sp.)

Plate IX., figs. 4, 4a.

Shell subovate, spire short, body whorl about three-fourths of the entire length; umbilicus entirely closed.

Whorls four, the early ones rounded but somewhat angular above and a little compressed at the sides; the sutures becoming more distinctly impressed as the shell increases in size. In the last volution and in part of the preceding one, the upper sutural edge is flattened, and forms a blunted angle with the side, the suture itself being lightly channelled. Below the narrow sutural shoulder the body whorl is flattened or slightly concave above the middle; beneath, or about the centre, it becomes moderately ventricose, and then narrows suddenly to the base. The umbilicus is completely covered, and this is partly due to a thickening of the columellar lip above. The aperture is rounded exteriorly, while on the columellar side its outline is concave above and convex below; the base seems to have been obtusely pointed.

The surface ornamentation consists of minute, transverse, raised striæ, which are rather irregular, and show a tendency to become arranged obscurely in bands. These transverse and crowded striations are crossed by similar though much more distant revolving lines, whose disposition is very variable. On the penultimate volution the decussation is extremely minute, but it appears to cover the whole area. On the body whorl the revolving striæ seem always present at or near the shoulder, and generally, though not always, in the centre of the volution. In every case the revolving striæ are much fainter than the transverse ones, and the former are often obsolete.

Total length of the largest specimen, rather more than nine lines from the apex to the base; height of body whorl about seven lines; maximum width of do., about six and-a-half lines.

Seven specimens of this species were collected, two of which are mere casts. None of them are quite perfect, although in two the characteristic sculpture is well preserved, and the description is, accordingly, compiled from a general average of the features shown by the whole collectively.

### Pseudomelania (?) (Sp. undt.)

A fragment of a large spiral shell, consisting only of about two and a half of the basal whorls, which may belong to this genus. The test is partly preserved on the last two volutions, but it is absent on nearly the whole of the upper whorl. Apart from the sutures, there are no spiral grooves on any part of the cast, and the shell is presumably therefore not a *Nerinæa*. The specimen is clearly part of an elongate, subulate shell, with smooth or only faintly striated whorls, and with the sutures not very deeply impressed. The volutions are much flattened, and the last one is

more than twice as high as that which precedes it. The test also is rather thick.

So far as can be ascertained from such an imperfect specimen, this species seems to be nearly related to such shells as the *Melania Heddingtonensis* of Sowerby,* to the *Chemnitzia Athleta* † D'Orbigny, and to other similar species described by the latter writer. Sowerby, indeed, describes his *M. Heddingtonensis* as having an infra-sutural carina, but that character is so often absent that it is not represented at all in any of the five figures of the species in the "Terrains Jurassiques."

The genus *Pseudomelania* was constituted by P. De Loriol for the reception of the large, smooth and elongated Oolitic fossils formerly referred to *Melania* and latterly to *Chemnitzia*. The so called *Chemnitziæ* of the Mesozoic rocks may have had tolerably near affinities with such genera as *Eulima* or *Eulimella*, but scarcely with the minute recent shells, with cancellate sculpture, once referred to *Chemnitzia* but now usually included in Risso's genus *Turbonilla*.

The nearest Cretaceous representatives of this species are the *Turritella Renauxiana* and *Eulima amphora* of D'Orbigny.

### Scalaria Albensis (? ?) D'Orbigny.

Plate IX, figure 5.

Scalaria Albensis, D'Orbigny. "Paléontologie Française, Terrains Crétaces," Vol. II., pp. 51, 52. Atlas, Plate CLJV., figs. 4 and 5.

The fragment represented on Plate IX agrees remarkably well, so far as it goes, with D'Orbigny's descriptions and figures of the *Scalaria Albensis*, a Lower Neocomian fossil from the Department of Yonne, in France. The original diagnosis of that species is as follows:—"S. testâ turritâ, imperforatâ, transversim tenuiter striatâ, longitudinaliter costatâ: costis flexuosis, obtusis, anticè posticèque evanescentibus; spirâ angulo 13°, ultimo anfractu non carinato; aperturâ subrotundatâ." The mouth of the only specimen from the Queen Charlotte Islands is broken off, but otherwise the characters of both seem identical.

On the other hand, there is reason to doubt whether some of the Cretaceous shells placed by D'Orbigny in the genus *Scalaria* really belong to the family Scalidæ. In an article on Cretaceous Gasteropoda, contributed to the "Geological Magazine," for March, 1876, the author, Mr. J. Starkie

* "Mineral Conchology." Plate XXXIX, figure 2.

† "Paléontologie Française. Terrains Jurassiques." Plate CCXLV, figure 1.

Gardner, says of *S. Clementina* Mich., "I have had an opportunity of examining the original of D'Orbigny's figure in the 'Paléontologie Française' at the Ecole des Mines, and find that the drawing represents the whorls more convex and inflated than they really are, and *the aperture is a restoration*. Again, speaking of *S. Dupiniana* D'Orbigny, the same writer says :—"The mouth is very imperfect, and has evidently been restored in the drawing." So rare is it to find the aperture perfect in shells of this group, that out of twenty British species supposed to belong to the Scalidœ, Mr. Gardner has only seen one with the outer lip perfect.

The distant rib-like folds which become obsolete above and below in Mr. Richardson's specimen, are very unlike the varices of *Scalaria* or *Opalia*, which are not only continuous from suture to suture, but which also frequently traverse nearly the entire length of the shell. The relations of the present species are probably nearer to *Aporrhais*, or even to *Potamides* or *Cerithidea* in the family Cerithiadæ, than to the Scalidæ.

Mr. Gardner justly remarks ("Geological Magazine," February, 1876, page 76), "There is some analogy between fragments of *Scalaria* and *Aporrhais* when the last whorl is not present." It is difficult to detect much difference between the present fragment and the shell figured by Sowerby* as *Rostellaria elongata*, except that the whorls of the former are very much flatter and less conical than is the case with the much better specimens of the same shell recently figured by Mr. Gardner as *Aporrhais elongata*.

Possibly the affinities of the Queen Charlotte Island shell may have been with some of the European Wealden or Purbeck fossils (such as *Potamides attenuata, tricarinata* and *harpœformis*) formerly referred to *Melanopsis* but now included in Brongniart's genus *Potamides*.

### Pleurotomaria Skidegatensis. (N. Sp.)

Plate IX, figures 6, 6a.

Shell turbinate-conical, wider than high; spire shorter than the body whorl; umbilicus deep but narrow, less than one-third the diameter of the base. Whorls five, those of the spire bluntly and obscurely angulated about the middle. The angulation is scarcely perceptible in the first two volutions, but the two specimens yet obtained are much worn; the apex appears to have been obtuse. Below the central angle the

* "Transactions of the Geological Society of London." Second Series, Vol. IV., page 336, Plate XI, fig. 6.

whorls of the spire are compressed in a direction nearly parallel with the axis; above it the flattening is oblique but almost horizontal. The body whorl is also bluntly but conspicuously angulated at, or a little below the middle; the upper half is obliquely flattened, and the base is depressed and gently convex. The outer lip is angular below the middle, also at its base; the columellar lip is nearly horizontal, and together with the outer lip, merges into the commencement of the next volution above. Behind the columellar lip there is a deep but narrow umbilical excavation, but this does not apparently expose any of the inner whorls.

The shell is everywhere encircled by revolving raised lines. Below the mesial angle of the body whorl these are simple, equidistant and regularly arranged. Although moderately prominent, they are obtuse and rounded; the grooves between them are about equal in width to the lines themselves. Upon the whole of the spire and on the upper half of the body whorl the revolving lines are finer, more irregularly disposed and show a decided tendency to arrangement into bundles. On the upper part of the shell the revolving striæ are crossed by obliquely transverse lines, which in one instance, at least, are directed backwards. These are entirely absent on the basal portion. The transverse striations are not interrupted by the revolving lines, except perhaps at the median angle upon which the band of the sinus is placed, but pass continuously over them. The effect is that the revolving lines have a more or less beaded appearance, and this is particularly well seen above and below the median angle of the penultimate and antepenultimate whorls. The beading is rather distant, and seems to become obsolete near the aperture.

The "band of the sinus" is only seen in a single place on the penultimate whorl of one of the specimens. It is flattened above and below, and its centre is traversed by a single, clearly-defined, raised line; its whole area being marked by close set, fine and delicate striations. These latter are each shaped like a V placed sideways, the apex of the letter being directed backwards. They run almost exactly parallel to each other, but are so minute as to be scarcely visible to the naked eye. No distinct margin can be traced on either side of the band, but the sculpture of this part of the shell is very imperfectly shown at the best.

Only three examples were collected, one of which is a mere cast. The other two are so much distorted that the exact measurements could not be ascertained. The shell is only partly preserved on these, and the figures therefore on Plate IX. are partly restorations. The specimen

selected for illustration happens to be distorted in such a manner as to make the transverse striæ appear to be directed forwards, but in another individual they certainly incline backwards, and this is probably their normal arrangement.

ACTÆON, (Sp. undt.)

In breaking up some pieces of shale from either Maud or Lina Island, six specimens of a small gasteropod were discovered, which perhaps belong to this genus. The test is not preserved in any of them, so that their distinctive features are unknown, and it is also doubtful whether there are two species, or only two different stages of growth of the same shell. Four of these are composed of three whorls, of which the last one is at least three times as high as the spire. The general shape is ovate; the body whorl is inflated and evenly rounded above; the sutures are not channelled. In the two remaining specimens the spire is broken, but the body whorl is narrowly cylindrical and much elongated, it is distinctly shouldered and angular above, and the sutures (of the cast) are deeply grooved. The whole of the specimens have one feature in common, and that is that the last volution of the casts is encircled or impressed by revolving grooves.

No traces of a thickened lip can be detected, and these little shells are therefore placed in Montfort's genus *Actœon* (of which *Tornatella*, Lamarck, is a synonym) though they may possibly prove to be *Cinuliæ*.

ACTÆONINA, (Sp. undt.)

A narrowly cylindrical and short-spired shell which very closely resembles some of the European Oolitic Actæoninæ, is abundant in pieces of shale from the islands in Skidegate Channel. The specimens occur as mere casts, which have been subjected to almost every variety of compression and distortion. In an average example, about an inch long the body whorl occupies nearly eleven-twelfths of the entire length. It is bluntly angular above, and faintly striated longitudinally. In some specimens the apex of the spire is obtuse, in others it is acute. The umbilicus is entirely closed, and no traces of any plaits at the base of the columella could be detected, though the latter circumstance may be attributable to the imperfect state of preservation of the fossils. They are indeed in such bad condition that their generic position even is uncertain.

## LAMELLIBRANCHIATA.

### MARTESIA (?) CARINIFERA. (N. Sp.)

Plate IX, figure 7.

Shell tumid and ventricose in front, narrow and attenuate behind; about one-third longer than high. The thickness at the anterior end equals or slightly exceeds the height, and the posterior compression is much greater in a lateral than in a horizontal direction.

The superior border is straight, but slopes gently downwards to the posterior end; the umbonal region is swollen and the antero-dorsal margin is raised and rounded. The beaks themselves are anterior, terminal, prominent, incurved and approximating. The lower half of the anterior margin is truncate obliquely, though almost horizontally; its base is rounded, and above the middle it seems to have been produced into a more or less rounded lobe on each side, which extend upwards so as to just touch each other immediately below the beaks. The edges of the valves at this end are a little broken in the only specimen collected, so that the outline of the anterior extremity cannot be very clearly ascertained. The pedal opening or anterior gap is large and wide, it appears to have been nearly diamond-shape, but the upper half probably had concave sides, and was shorter than the lower. The height and width of the pedal opening were apparently about equal.

The posterior margin is obliquely subtruncate, bluntly angular and pointed below, less so above. The ventral border is straight, but trends slightly upwards towards the posterior end; its termination in front is abruptly rounded, and bluntly angular behind.

On each valve a slightly flexuous raised ridge runs obliquely from behind the beaks to the posterior end of the basal margin, and separates a small, excavated and nearly triangular posterior area, from the central part of the shell. The middle of the valves is also divided by two transversely oblique and slightly divergent grooves (which pass from the beaks to the ventral margin) into three unequal and differently shaped spaces. Of these, the posterior is the largest, the centre one the smallest, while the anterior space is of medium size. The latter is marked near its front boundary by two raised lines, which pass from the beaks to the base, and in so doing cut or divide off, as it were, the two lobes at the front end from the main body of the shell.

A small portion of the test is preserved on one of the valves, and under

the lens its surface is seen to be minutely and concentrically ribbed, the ribs following the general outline of the shell.

Length, three and-a-half lines; greatest height about two and-a-half lines; maximum width (or thickness) about equal to the height.

A single specimen, burrowing into fossil wood.

The solitary example from which the above description was made, is both imperfect and immature. At present it is not known whether the anterior hiatus was permanently open or closed in the adult by a calcareous secretion. Not a vestige of any of the accessory plates remains, and their number, shape and position have yet to be ascertained. The generic position of the shell can, therefore, only be inferred by analogy, and that in a very vague and unsatisfactory way at best.

The somewhat elongated shape, coupled with other characters, indicate that the species should be referred to the Pholadinæ rather than to the Teredinæ, and its relations are apparently either with *Martesia* or *Parapholas*. The essential distinction between these genera is that in *Parapholas* the umbonal accessory valve is "longitudinally divided in two," while in Martesia it is single and entire. Stoliczka* is of opinion that "the distinction scarcely deserves to be regarded of generic value." Woodward† defines the genus *Parapholas* briefly thus, "valves with two radiating furrows." Stoliczka‡ says "the two furrows running from the umbones towards the periphery are said to be present in all known species of *Parapholas*," and a part of Tryon's diagnosis of the genus § is, "surface impressed by two oblique sulci, extending from the beaks to the margins."

Conrad's genus *Parapholas* was proposed by him in 1849, and the type species is admitted to be the *Pholas Californica* of the same author, which has only one groove on each valve! In describing that species the writer says, "valves much contracted submedially, with an oblique groove." Chenu accordingly calls *P. Californica* a *Martesia* and not a *Parapholas*.

Tryon, whose monograph on the recent Pholadaceæ (in the "Proceedings of the Academy of Natural Sciences of Philadelphia for 1862") has done so much to clear up the confused synonymy of the group, makes no reference to the fossil species. As he includes several forms, (such as the Californian *Pholas calva* of Sowerby) which have two oblique furrows on each valve, in Leach's genus *Martesia* as recently

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* "Cretaceous Pelecypoda of Southern India," page 24. † "Manual of the Mollusca," page 329.

‡ "Cretaceous Pelecypoda of Southern India," page 24.

§ "Proceedings of the Academy of Natural Sciences, Philadelphia, 1862," page 194.

restricted, and as the type of *Parapholas* has only one, the Queen Charlotte Island fossil is, for the present, regarded as a *Martesia*. It is not improbable that the two genera will ultimately be merged in one, and in that case *Martesia*, which is much the oldest name, will have to be retained.

*Martesia tundens* of Stoliczka, from the Cretaceous rocks of Southern India, in its young state nearly resembles the present species, but the Asiatic shell is more elongated and acute behind, and its valves are marked by only one impressed groove.

### Thracia (Sp. undt.)

Compare Lutraria (Thracia ?) carinifera, Sowerby. "Mineral Conchology," Vol. VI., p. 66, Plate DXXXIV, fig. 2. (=Lyonsia (? Thracia) carinifera, (Sow.) D'Orbigny. "Paléontologie Française, Terrains Cretaces," Vol. III., page 385. Atlas, Plate CCCLXXIII., figs. 1 and 2.

A single imperfect cast, with the surface much abraded, which clearly belongs to the same genus as the fossil with which it has just been compared, and is very much like it specifically. Both are squarely truncate behind; in each there is an oblique ridge or keel which extends from the beaks to the posterior end of the base; and there is a certain resemblance in the general outline of both. Still, the two species are entirely distinct; the beaks in Mr. Richardson's specimen are divergent and wide apart, they are placed also at a considerable distance behind the middle, and consequently the shell is produced anteriorly and very short posteriorly. In *Thracia carinifera* the beaks are close together and nearly central, while the length of the shell is greater in proportion to its height than is the case with the species from the North Pacific. The only specimen of the latter is too imperfectly preserved either to permit of a sufficiently accurate description being made, or for a satisfactory comparison with closely allied forms.

Agassiz places Sowerby's *Lutraria carinifera* in the genus *Corimya*, but Stoliczka, who favours keeping *Corimya* and *Thracia* apart, thinks that it may be a *Thracia*, although he previously states that "fossil species belonging to *Thracia* proper are as yet only known from Tertiary deposits; those from Cretaceous beds may, with equal probability, be referred to the former genus" (*Corimya*). Pictet states more positively that it is a Thracia.

### THRACIA, (Sp. undt.)

Perhaps Corimya (? Thracia) Nicoleti, Agassiz. "Etudes critiques sur les Myes Fossiles." Livraison IV., page 272. Plate XXXVII, figures 1-6.

Compare also Corimya Studeri Ag. (=Tellina incerta, Thurm.)

Three broken and distorted casts of a typical species of Corimya (or Thracia) whose shape and surface markings are undistinguishable from those of the *Corimya Nicoleti* figured in the memoir above cited. In the most perfect of these specimens there are two narrow grooves on the right valve, which run obliquely from the hinge margin, behind the beaks, towards the upper part of the posterior end, but which are nearly parallel to the superior border behind. These of course indicate the presence of as many raised lines on the inner surface of that valve. Similar markings on the interior of the valves are not shewn quite so distinctly in the original illustrations of *C. Nicoleti*, nor is anything said about them in the text. Still, Mr. Richardson's specimens agree in every essential point with the description of that species, but they are so imperfect that their identification is uncertain and must be so until a better series is obtained. Goldfuss' figures of *Corimya Studeri*, under the name *Tellina incerta*, Thurman, are also very like the Queen Charlotte Island shell.

Most palæontologists have agreed in uniting Agassiz's genus *Corimya* with *Thracia* of Blainville, although this view was opposed by the late Dr. Stoliczka. If the two genera are to be kept separate, the present species, with its compressed rather than inflated form, and especially in its having "two long ribs running from the beaks posteriorly," belongs rather to *Corimya* as re-defined by Stoliczka, than to *Thracia* proper.

### PLEUROMYA (?) CARLOTTENSIS. (N. Sp.)

Plate IX, Figure 8.

Shell slightly inequivalved, moderately convex in front, concavely attenuate at the sides behind. Outline elliptic ovate, short and narrowly rounded in front, produced and bluntly pointed at the base, posteriorly; length rather more than a third greater than the height.

The beaks are situated at a distance of about one-fourth from the anterior end; they are wide, but not very acute; their apices are curved inwards and a little forwards. Behind the umbones the hinge line is nearly straight but somewhat concave, its general direction is downwards. The ligamental area is lanceolate in outline, but not very clearly defined,

although there is a faint angularity which extends from the beaks to the posterior end of the hinge margin. The posterior end is broken but it seems to have descended in a gently convex, oblique curve to the ventral margin, which is very broadly rounded. In front of the beaks, but below them, there is a concave, but not very deeply excavated or definitely margined, lunular area; the anterior extremity is narrowly rounded, but slightly angular below.

Surface strongly and concentrically ribbed; the ribs rather obtuse and separated by deep, concave grooves.

Greatest length of the shell, one inch and eight lines; height, one inch one line and a half; maximum width or thickness, not quite eight lines.

The only specimen is a somewhat distorted cast, which is imperfect at the posterior end.

The shell is provisionally included in Agassiz's genus *Pleuromya*, as restricted or re-defined by Terquem, on account of its general shape and strong concentric costation; although it may be a *Panopæa*. Morris and Lycett, in their monograph of the Great Oolite Mollusca, and other writers who have accepted their conclusions, have reunited *Pleuromya* with *Myacites* of Schlotheim, and group the latter genus in the Anatinidæ. Stoliczka considers the former part of this hypothesis to be an "inadmissible generalization of characters," and believes that Terquem has sufficiently proved the distinctness of Agassiz's genus *Pleuromya*. Pictet in his "Traité de Paléontologie," (Vol. III., p. 360) goes still further than Morris and Lycett, and unites *Myopsis*, (Agassiz), *Pleuromya*, (Agasssiz), *Homomya*, (Agassiz), and some other genera, with *Panopæa*; he also places the latter genus (with *Pholadomya*) in his family Myacidæ.

Admitting, for the present, that *Pleuromya* may be a good genus, it seems to be capable of division into two well-marked sections. In the first, the beaks are placed very far forwards, and the surface is strongly costate; in the second, the umbones are situated near the middle, and the valves are only striated concentrically. *Pleuromya Carlottensis* probably belongs to the first of these divisions, which contains some species which have been referred to *Gresslya*.

The whole of the Mesozoic Anatinidæ or Myacidæ, (for the same genera have been placed in both families by different writers), are very imperfectly understood, nor is this circumstance to be wondered at. Although abundant in and eminently characteristic of the rocks of that epoch, the specimens usually met with are little more than badly preserved casts, from which the whole of the thin test has been removed. The microscopical characters of the shell, the nature of the hinge teeth and of the muscular

impressions can rarely be ascertained, or even the true surface markings. As the whole of the above remarks apply with full force to the present fossil, it may be easily imagined that its generic position is doubtful. Further, the only specimen yet collected has had its original shape so much altered by compression that the specific description may have to be materially modified or altered, when better examples have been obtained.

### Pholadomya ovuloides. (N. Sp.)

Plate IX, figure 9.

Shell swollen and ventricose in front, rapidly decreasing in thickness behind; height more than one-third less than the length; outline subovate. The superior border is straight and nearly horizontal, if viewed laterally, but as seen from above it is concavely inflected on each side, and the result is that there is a well-defined, narrowly lanceolate, excavated escutcheon. The inflection is so decided as to present the appearance of an obtuse ridge on each valve, and both of these extend in a slightly convex curve from behind the umbones to the posterior end of the hinge line, which is sunk below their level. The umbonal region is much inflated, but the beaks themselves are not very large, and do not project much above the hinge margin; they are situated very near the anterior extremity, but are not quite terminal; their apices are incurved, approximating, and point very slightly forwards. In front of, but just under the beaks, the hinge line is short, straight, and oblique, with a distinctly downward slope; there is no lunule. The anterior prolongation of the hinge line is mostly concealed by the upward swell of the beaks, so that in some aspects there appears to be a concave lunular declivity. The anterior end is angular a little above the middle, subtruncate in the centre, and somewhat rounded at the base. The basal margin is regularly semiovate (that is, on the supposition that the ovoid be divided in the direction of its greatest length) the most prominent part being about or behind the middle, the upward trend being greatest posteriorly. The posterior end is narrowly rounded, and judging by the lines of growth, a little angular at is junction with the hinge border above. In front and below, the valves seem to have been nearly closed; behind they gape very slightly.

The surface is marked by concentric ribs or rib-like folds, which are separated by narrow grooves. Both are very irregular in their disposition, and are often partly divided longitudinally, so that they are rarely continuous from end to end. There are also a few, very faint, radiating

lines, about twelve in number, which cross the concentric ribs, but which do not give a nodular appearance to the sculpture. These radiating striæ can only be seen in a rather strong light; they are most conspicuous on the upper surface of the valves, and become obsolete near the base, also at the anterior end.

As the above description was made from a mere cast, it is probable that the sculpture of the test was much more decided than it is in the only specimen now accessible.

Greatest length, about nineteen lines; maximum height nearly twelve lines; extreme width or thickness, eleven lines.

This fossil belongs to the second of Agassiz's divisons of the genus, the "Pholadomyes avec un Aire Cardinale Circonscrite,"* also to the fifth section of that group, the "Pholadomyes Ovalaires."†

Among European forms its analogies are with such species as *P. modiolaris*‡ and *P. ovulum*§ of Agassiz, particularly with the latter. In the first, a broad groove traverses the valves obliquely near the anterior end, and this is not present in *P. ovuloides;* in the second, the hinge line is not produced much beyond the umbones in front, nor is the anterior margin angular above; the opposite being the case in specimens of *P. ovuloides.*

In the Cretaceous rocks of North America there are several species of *Pholadomya*, which bear a considerable resemblance to *P. ovuloides*, and the *Pholadomya papyracea* of Meek and Hayden,‖ from the Upper Cretaceous of Chippeway Point near Fort Benton, on the Upper Missouri, in particular has a very similar shape, and almost exactly the same sculpture. Still, *P. papyracea* is a much more compressed shell than *P. ovuloides;* the anterior end of the former is not angular above; and the hinge margin of *P. papyracea* is "not inflected so as to form a defined false area." The inflection of the hinge margin of *P. ovuloides* is very decided, and this feature alone will serve to discriminate between the two species.

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* "Etudes Critiques sur les Mollusques Fossiles." Livraison II., page 103.

† Idem, page 113.

‡ Idem, page 123. Plate III. *a*, figs. 1—6.

§ Idem, page 119, Plate III., figs. 7—9. Plate III. *b*, figs. 1—6.

‖ "Proceedings of the Academy of Natural Sciences, Philadelphia, 1862," page 28. Also, "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." By F. B. Meek, Washington: 1876. Page 217, Plate V., figs 4, *a*, *b*.

LUCINA. (Sp. undt.)

Plate IX., fig. 12.*

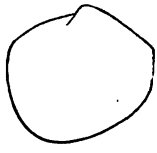

FIG. 6.

Compare *Lucina subundata*, Hall and Meek. "Memoirs of the American Academy of Arts and Sciences." Cambridge: 1856. Page 384, Plate I., figs. 6, *a*, *b*. Also, Meek's "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." Washington: 1876. Page 133, Plate XVII., figs. 2, *a*, *b*, *c*, *d*, *e*, *f*; especially 2, *f*.

Shell compressed, thin, sub-circular, but more or less angular; broad in front, narrow behind; length rather greater than the height. The beaks, which are placed a little on the posterior side of the middle, are not very small; they project distinctly above the highest level of the hinge line, and are directed forwards. There is no clearly defined lunule, and the escutcheon is merely a linear lanceolate groove, with obtuse margins, for the reception of the ligament. The superior border is broadly triangular; the anterior side is wide and somewhat squared, but the upper angle is slightly in advance of the lower, and the latter is the most rounded off of the two. The basal margin is gibbous in front, but abruptly contracted behind; the posterior side narrows rapidly both above and below; its extremity being squarely truncate.

The surface is so much worn that the only markings visible are a few faint concentric striæ of growth; the characters of the interior of the valves are unknown; the test is extremely thin.

Greatest length of the only specimen, nine lines; height, from the beaks to the base, about eight lines; maximum thickness, four lines.

The differences between this little shell and some examples of *L. subundata* are very slight. The posterior half of the large individual of the latter species, figured by Mr. Meek in the Report quoted above, (at Plate XVII., fig. 2, *f*,) almost exactly corresponds with that of the present fossil, but the shape of the anterior side of the two shells is

* As this figure does not convey a very accurate idea of the shape of the shell, a more correct outline is given in the woodcut.

somewhat different. In *L. subundata* the front half of the superior border is represented as nearly horizontal, and the anterior side as broadly rounded; whereas in the specimen now under consideration the hinge margin in front is oblique, and the anterior side sub-quadrate. Such a slight variation in outline can scarcely be regarded as of specific value, but the fossil just described is too imperfect to be satisfactorily identified.

### LUCINA. (?) (Sp. undt.)

**Probably the adult state of the preceding.**

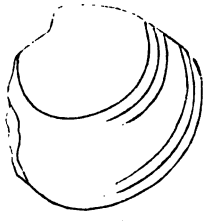

FIG. 7.

Compare *Lucina occidentalis, var. ventricosa*, Meek and Hayden. "Proceedings of the Academy of Natural Sciences of Philadelphia, 1860," page 427, as *L. ventricosa.* Also, Meek's "Report on the Cretaceous and Tertiary Fossils of the Upper Missouri Country," &c., page 135, Plate XVII., figs. 3, *a*, *b*, *c*.

Shell compressed, suborbicular, not at all angular, broadly rounded in front, narrower behind; length rather greater than the height. Beaks small, sub-central or a little in advance of the middle, scarcely raised above the highest level of the hinge margin. Superior border slightly convex and sloping gently downwards posteriorly, more abruptly so towards the anterior end. Ventral margin gibbous in front, contracted behind; posterior extremity narrowly rounded, or perhaps very bluntly pointed about the middle, but apparently not at all truncate.

The sculpture seems to consist of fine and closely arranged concentric striæ, but the surface is much worn. The dentition of the hinge and the other markings on the interior of the valves are unknown.

The specimen from which the above description was made is much broken at the anterior end, but, judging by the lines of growth, the dimensions are nearly as follows:—Estimated length, thirteen and a half lines; actual height, in the middle, twelve and a half lines; actual thickness, six lines.

Although it is almost certain that this shell is nothing more than the adult stage of the preceding species, it has been thought better to describe the two specimens separately. Both are broad in front and narrower behind; they agree, also, in other characters, such as the absence of a defined lunule, and the shape of the escutcheon. The only difference of any consequence is the position of the beaks, which are placed behind the centre in the small specimen, and a little in advance of it in the larger one. But Mr. Meek's figures of different specimens of *L. subundata* and *L. ventricosa* show that these two species vary in a precisely similar way. The same writer doubts whether *L. subundata*, *L. occidentalis* and *L. ventricosa* are more than varieties, or different stages of growth, of one species, and it certainly seems probable that such may be the case. The larger of the two *Lucinæ* from the Queen Charlotte Islands has almost exactly the shape of one of the specimens of *L. ventricosa* as represented by Meek, (Report cited, Plate XVII., fig. 3, *b*, *bis.*,) except that the beaks of the latter are placed behind the centre, and that its posterior end is sub-truncate.

### CALLISTA (?) SUBTRIGONA. (N. sp.)

Plate IX., fig. 10.

Shell moderately compressed, ovately triangular, bluntly pointed or subangular about the middle in front, and a little below it behind; length rather greater than the height; test very thin.

The beaks, which are placed at about one-fourth of the distance from the anterior end, are of medium size; their apices are directed forwards, and sunk a little below the highest level of the hinge line. There is no lunule, and the escutcheon is a narrowly lanceolate groove with almost vertical sides. The posterior half of the shell is somewhat produced and sub-angular below the middle; the superior border behind and the margin of the posterior end are united in one bold and unbroken convex curve, which extends from the beaks to the ventral margin. The downward direction of this curve is, however, most decided below the termination of the hinge line. The basal margin is broadly but unevenly rounded, the front half being most projecting and the hinder half rather more contracted. Below the beaks, in front, the superior border descends obliquely in a straight or slightly convex line, and forms a sub-angular junction with the ventral border at the centre of the anterior end.

The external sculpture consists of very fine and close set concentric striæ. The markings on the interior can only be traced, and that very obscurely, on the right valve of one of the casts. In this valve there are indications of three cardinal teeth, which diverge widely from above downwards. The anterior tooth is oblique and almost longitudinal; the centre one is short, triangular, and nearly transverse to the hinge line; while the posterior tooth is long, oblique and directed backwards. The pallial impressions seem altogether obliterated.

In an average specimen, the length is rather more than fifteen lines; the height, in the centre, is thirteen lines; and the thickness through the valves, six lines.

Nine or ten specimens were obtained by Mr. Richardson, three of which are quite perfect, with the shell preserved on both valves. The outline of the species is very variable, some specimens being nearly ovate while others are subtrigonal. *C. subtrigona* is a flatter shell with a more triangular form than *C. Deweyi* of Meek and Hayden,* and *C. orbiculata* of Hall and Meek† has the posterior side more broadly and evenly rounded. The figure on Plate VIII. represents a variety in which the anterior and posterior ends are not nearly so much pointed as usual.

### Callista. (?) (Sp. undt.)

Plate IX., fig. 11.

Shell compressed, but rather tumid in the middle; very inequilateral; outline elongate ovate; length about a fourth greater than the height; test very thin. The beaks are situated very near to the anterior end, but are not quite terminal; they are small and point forwards, but their apices do not rise above the highest level of the hinge border. There seems to be no lunule proper, and the escutcheon is a narrowly lanceolate deep groove, which is bounded on each side by a sharp ridge. Behind the beaks the hinge line is almost straight, and its downward curve is very gentle; the posterior end is narrowly, and the basal margin broadly rounded. Immediately below the beaks, in front, a short and concave lunular declivity extends to a little above the middle of the

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* "Proceedings of the Academy of Natural Sciences of Philadelphia, 1856," page 83. "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." By F. B. Meek. Washington: 1876. Pages 182-3, Plate XVII., figs. 15, *a*, *b*, *c*, *d*, *e*.

† "Memoirs of the American Academy of Arts and Sciences, Cambridge." Vol. V New Series. Pages 382-3, Plate I., fig. 7. "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," &c., pages 186-7, Plate V., figs. 2, *a*, *b*, *c*.

anterior end, beneath which the latter is narrowly rounded. The beaks being nearly terminal, the anterior portion of the shell is very short, and the posterior much elongated. Apart from the irregularity caused by the beaks, the general outline is almost that of a pure ovoid, the height being rather greater in front than behind.

The surface is marked by rather coarse and unequal concentric striæ of growth, but the sculpture is much eroded. Judging by the impressions on a broken cast, the hinge teeth seem to have been of the same number and shape as those of the preceding species.

Length of the most perfect specimen, one inch; height, in the middle, nine lines; maximum thickness, five and a half lines.

A single example, with the test imperfectly preserved on one valve, and a fragment of the cast of another.

This little shell appears to have some distant analogies with the *Callista tenuis* of Hall and Meek, * and with the *Venus sublævis* of Sowerby, † but the generic position of the present fossil is so uncertain that it would be a waste of time to speculate upon its specific relations with such imperfect materials at hand for comparison. It is just as likely to be a *Tapes* or an oval *Cyprimeria* as a *Callista*.

Besides the two *Callistæ* just described, there are a few large casts in a very poor state of preservation. Judging only by external form, some of these at least may have belonged to the Veneridæ, although no indications of the pallial sinus characteristic of that family as opposed to the Glossidæ, can be traced in any of them. The most perfect specimen, which measures two and a half inches in length by two inches in height, has much the general shape of *Cyprina ovata* of Meek and Hayden, ‡ but that species has a less swollen umbonal region, and its test is comparatively thick. That of the Queen Charlotte Island shell is extremely thin and fragile.

### Unio Hubbardi, Gabb.

Plate IX, figure 13.

*Unio Hubbardi*, Gabb. "Palæontology of California," Vol. II, pages 190-91, Plate XXX., fig. 85.

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* "Memoirs of the American Academy of Arts and Sciences, Cambridge," Vol. V. New Series, Plate I., fig. 5. "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," &c., page 188, Plate V., figs. 1, *a* to *d*.

† "Transactions of the Geological Society of London." Series IV. Vol. II., page 342, Plate XVII., fig. 5.

‡ "Proceedings of the Academy of Natural Sciences, Philadelphia, 1857," page 144. "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," &c., page 146. Woodcut especially.

Perhaps = *Unio Aduncus*, Sowerby. "Mineral Conchology," Vol. VI., page 190, Plate DXCV., figs. 2, 2.

Shell convex, elongated; outline ovately triangular or ovately wedge shaped; anterior side short and rounded; posterior side long and bluntly pointed at the extremity; length greatly in excess of the height. Beaks moderately large, compressed at almost a right angle to the sides of the valves, incurved, pointing slightly forwards, and placed at a distance of about one-fourth the length from the anterior end. Lunule none; ventral margin straight, or a little concave behind the middle, more prominent under the beaks, and curving up regularly in front. Posterior side very variable in shape, usually moderately elongated and subtriangular, but sometimes much more lengthened and narrowly attenuate. In the typical form the hinge margin slopes convexly and rather rapidly downwards from behind the beaks, and the posterior extremity still more abruptly so, the latter being bluntly pointed below. The normal contour of this part of the shell is elongately subtriangular, two of the sides being gently convex and the central angle rounded.

In an exceptionally lengthened variety the posterior side is narrowly attenuated and wedge shaped; the hinge border descends obliquely in an almost unbroken straight line, and the posterior extremity is narrowly rounded.

A blunt ridge extends downwards and backwards from the beaks to the posterior end of the base, and in so doing separates an obliquely flattened area from the rest of the shell. The ligament is external and proportionately rather narrow.

The surface is marked by coarse and irregular lines of growth; the beaks, which are often much eroded, are undulately corrugated when perfect.

Out of thirty specimens collected by Mr. Richardson, twenty-nine have both valves, with the test, preserved, and the ligament even is visible in some. In every case, however, the posterior extremity, which is the thinnest and therefore weakest part of the shell, is broken off. Sometimes the surface of the test is partly covered by a thin film of pyrites.

The only detached valve collected, a right valve, having been soaked a long time in water, an attempt was made to remove the matrix thus softened and to expose the hinge teeth. Although the rather thick test broke in pieces during the operation, it was found that besides the ordinary cardinal teeth, there was a longitudinal groove in the right valve, for the reception of a corresponding lateral and laminar tooth in

the left. The shell, therefore, is clearly neither an *Anodonta* nor a *Margaritana.*

Estimated length of a fairly typical specimen, two inches and nine lines; actual height of do., from beaks to base, one inch and nine lines; maximum thickness, one inch and three lines.

Probable length of a much more elongated individual, three inches and one line; actual height from beaks to base, (the beaks being much eroded) one inch and eight lines; thickness, scarcely fifteen lines.

The shaded part of the figure on Plate IX. is intended as a representation of the elongated and attenuated variety of this species. In this instance the dotted lines are not added by way of restoration, but to show the shape of another individual. The majority of specimens are much shorter, and the downward slope of the anterior extremity is usually more decided. Mr. Gabb's partly restored drawing of the original type is slightly inaccurate; the hinge border behind is too straight and its downward inclination is not sufficiently expressed. The posterior end is too wide and its upper margin not convex enough.

The locality from which *Unio Hubbardi* was first obtained is thus described by the author of the species: "A single specimen, from the Nanaimo Coal Mine, Vancouver Island, Chico Group, kindly loaned me by Mr. Hubbard, of the Pacific Mail Steamship Company of San Francisco, and to whom I dedicate this species, in recognition of the unostentatious but valuable services he has been rendering to science for a series of years past." The statement that this fossil was found in the Cretaceous Coal fields of one of the Islands of the Vancouver group, is probably a mistake. At any rate it has not been recorded by any subsequent observer as occurring in that region, nor can any trace of it be found in the large and important collections made by Mr. Richardson at these islands during the past five years. On the other hand, it is not only one of the commonest species in the Carbonaceous Shales near Cowgitz on Graham Island, but it is the only mollusc yet detected in them.

The elongated and attenuated variety of *U. Hubbardi* described above, is barely distinguishable from the *Unio Aduncus* of Sowerby, a fossil from the Wealden Formation of Tilgate forest, in England. *U. Aduncus* seems to be rather straighter at the anterior margin, and its base is apparently rather more gibbous under the beaks than are the corresponding parts of the Queen Charlotte Island shell, but these differences do not appear to be constant, and in any case are scarcely of specific importance. The figures in the "Mineral Conchology" are taken from

broken examples, and the descriptions of the species are very short and indefinite.

The posterior pointed extremity of the English specimens are broken off, just as they are in the shells described above. In North America, as most collectors are aware, the pointed ends of the valves of living Unionidæ are often bitten off by muskrats and other animals, whose instinct teaches them which is the most fragile part of the shell and how best to get at the (to them) luscious morsel inside. In the case of the fossils, however, the fracture is probably accidental.

### Trigonia diversicostata. (N. Sp.)

Plate X., figure 1.

Shell moderately inflated, elongated, scaphoid or subarcuate, very inequilateral; anterior end short and rounded; posterior side produced, cuspidate and bluntly pointed above. Beaks large, projecting, recurved, anterior, nearly terminal. Lunule none; posterior area (of the two united valves) broadly ovate lanceolate, with a rounded margin. Hinge border, behind the beaks, straight or slightly concave, sometimes with a very gentle downward inclination, which becomes a little more decided at the tip of the beaked posterior extremity. Ventral margin broadly rounded, but the upward curve is always greatest behind. The short anterior end is always much wider than the posterior extremity, and the margin of the latter is convex below and almost straight above. As measured in the centre, behind the beaks, the height is less than half the length: the thickness or convexity is nearly equal to the height.

Surface boldly ribbed, with a very singular and complex style of costation. At the anterior end the general direction of the ribs is almost horizontal, but near the margin they are curved, and ultimately straighten and trend upwards. In the basal half of the shell, however, they are either undulated or broken up into a series of zigzags. Thirteen or fourteen of these horizontal ribs commenced at the margin of the anterior end; then, near the middle of the valves, five or six of them suddenly bend upwards at a sharp angle, and become either transverse, or at length incline a little forwards. About one-half of the ribs which proceed from the anterior end are not continuous, but are distinctly truncated by the upward bend of those which reach to the superior border. This is most obvious in the umbonal region, for on the beaks the first five anterior ribs are cut off, as it were, by the upward bend of the sixth. Below this the anterior costæ seem alternately continuous and interrupted.

Towards the posterior end, the ribs are transverse and cross the valves in a radiating manner, the radii being directed backwards. At their junction with the outer border of the hinge area, these posterior costæ are narrow above and widen symmetrically to the margin below or behind.

The posterior area is ribbed longitudinally; but the costæ are curved and follow its general outline. At first they are very narrow, and attain their maximum width at the point farthest from the beaks. In some specimens the ribs which traverse the valves behind bifurcate with those on the posterior area, and at the extreme tip of the beaked end the direction of both is not far from parallel.

The sculpture of this distinctly characterized species is subject to considerable variation. In one specimen the transverse ribs which proceed from the anterior margin, are bent into a series of zigzags before they take their final upward turn. In another distorted example the same ribs traverse fully two-thirds of the shell before they bend upwards, and their angles lie in the direction of a line drawn obliquely from the beaks to the base of the posterior end. In the majority, the longitudinal and transverse ribs occupy each about one-half of the surface, and the angles of those which so suddenly alter their course are placed in the direction of an obliquely concave line which might be drawn from the beaks to a little behind the middle of the base. Again, in one instance the costæ on the posterior area bifurcate distinctly with the transverse ribs on the main body of the shell, in other examples the latter are truncated by the former. In all cases, however, the ribs in front, though they trend upwards, and their course is more or less broken, are nearly longitudinal; on the posterior area they are decidedly so, while on the beaked posterior end and on the hinder part of the umbonal region they are transversely radiating.

Greatest length of the specimen figured, twenty-one lines; height in the centre, behind the beaks, nine and a half lines; thickness, nine lines.

Seven specimens were collected, some of which are a good deal distorted.

A curious little *Trigonia* of the Scaphoid group, easily recognized by its very peculiar sculpture. The only species with which it might be confounded is the *Trigonia Vau* of Sharpe* from Secondary and probably Jurassic rocks in South Africa. The shape of these two

* "Transactions of the Geological Society of London." Second Series. Vol. VII., page 194, Plate XXII., fig. 5.

fossils is almost identical, but the sculpture of each is very distinct. In *Trigonia Vau*, the ribs at the anterior end incline obliquely downwards before they change their course; in *T. diversicostata* their general direction is either longitudinal or upwards, but the most striking difference is in the markings on the posterior area of the two shells. In *T. diversicostata* that region is boldly and longitudinally ribbed; in *T. Vau* it is transversely striated and "divided into two parts by a slight longitudinal ridge."

TRIGONIA. (Sp. undt.)

**Plate X., figure 2, 2*a*.**

Shell compressed, elongate, subtrapeziform, narrowest behind; anterior end very short, posterior produced; length much greater than the height. Beaks small, anterior, subterminal, slightly recurved, not much elevated above the superior border. Lunule none; posterior area flattened laterally, with a rounded margin, made up of two elongately subtriangular spaces, one on each side of the hinge line; ligament external, short, thick, prominent and transversely striated. Hinge line straight, sloping gently downwards; posterior end obliquely subtruncate. Anterior end almost straight, but curved a little outwards; antero-ventral margin broadly rounded; base line convex in the middle, straighter, and curving much more gradually upwards behind.

Out of nine specimens on which the test is partly preserved and a number of imperfect casts, none shew the true characters of the whole of the surface ornamentation. The original of fig. 2, on Plate X., gives the clearest idea of the normal shape of the shell, besides showing the sculpture of the beaks and posterior area. Fig. 2*a*, on the same Plate, is a representation of the most perfect of four distorted individuals which have been compressed laterally, and whose exterior is either worn, exfoliated, or partly covered by the tenacious matrix. The only information afforded as to the sculpture of the main body of the shell, is that supplied by the four last mentioned examples. In these there appear to be about thirteen or fourteen obliquely transverse, concavely, curved rows of separate raised tubercles. The whole of the rows commence at the outer edge of the posterior area, and they all run obliquely downwards and forwards. Rather more than half terminate at the anterior margin, but just before reaching it they each turn abruptly upwards. The upward bend at the front margin consists only of a change of direction of the last tubercle, and there is a solitary intervening one, at

this end, between each of the two rows. The rest of the rows curve obliquely from the posterior area to the ventral border. One specimen shews very coarse and concentric raised striæ of growth, with corresponding grooves; also that the tubercles are longitudinally elongated. It is possible, indeed, that instead of rows of distinct and separate tubercles, the true sculpture may have consisted of oblique ribs which are interrupted and made tubercular by their being crossed by the concentric grooves just described.

The posterior area is transversely striated, and in one individual there is a faint longitudinal groove, bordered by an obtuse ridge, which runs the greater part of the length of its outer margin. Occasionally there are a few scattered tubercles in this region, but these are often absent, and when present are generally, though not always, most numerous near the beaks.

As none of the specimens are perfect or undistorted, it is not possible to give sufficiently exact measurements.

In 1873 Mr. Richardson collected a solitary specimen of a *Trigonia* at North West Bay, Vancouver Island, in a very fair state of preservation, which, in the writer's judgment, is scarcely more than a variety of *Trigonia Tryoniana* of Gabb.* Judging by the examples described above, the differences between the Vancouver and Queen Charlotte Island shells seem slight, but the resemblance may be more apparent than real, and may be mainly due to a want of knowledge of the distinctive sculpture of the latter.

The general shape, and the surface markings on the posterior area, are essentially the same in both. In the Vancouver fossil the central part of the valves is traversed by fifteen or sixteen oblique ribs, which commence at the outer limit of the posterior area. Nine of these terminate at the anterior margin and six cross to the ventral border, and the ribs increase more and more in their distance from each other towards the posterior extremity. The costæ are crossed by concentric and coarse grooves which give a subtubercular aspect to the ribs; in the umbonal region the tubercles are entirely distinct and separate. The upward bend of the tubercles just before reaching the anterior margin, and the occurrence of a single isolated one alternating at that end with each continuous series, two features which seem to be characteristic of the Queen Charlotte Island specimens, cannot be traced in the *Trigonia* from Vancouver. These are the only differences of any consequence that can be observed

* "Palæontology of California," Vol. I, pp. 188-9. Plate XXV., fig. 176.

between the specimens from the two localities; but, as has already been pointed out, the exact nature of the surface ornamentation of those from the islands in Skidegate Channel has yet to be ascertained.

Distorted examples, like that from which figure 2*a* on Plate X. was drawn, might be mistaken for the Oregon species doubtfully referred by Gabb * to the *T. Gibboniana* of Lea; but the normal shape of the two shells is quite distinct. The specimens described by Dr. Lea and Mr. Gabb clearly belong to the section Quadratæ, while the Queen Charlotte Island fossils would be more correctly placed among the Clavellatæ, which by some writers are united with the Scaphoidea.

### Yoldia. (Sp. undt.)

Compare Yoldia nasuta, Gabb. "Palæontology of California," Vol. I., page 216, Plate XXXII., fig. 287, and Vol. II., pages 58 and 103.

Shell, or rather cast, compressed, moderately thin, elongated; beaks prominent, recurved, placed a little in front of the middle. Cardinal margin slightly convex, sloping gently downwards in advance; concave, and at length curving upwards behind. On the cast, a blunt ridge, which extends from the beaks to the tip of the posterior extremity, marks out a lanceolate, escutcheon-like depression, and a similar but more acute ridge in front, defines another area of the same shape, which represents the lunule. These appearances, however, are probably due to the thickening of the hinge plate on each side of the ligament for the reception of the teeth. Margin of the anterior end narrowly rounded or subangular about the middle; ventral border broadly rounded, but curving upwards more decidedly behind than in front; posterior end moderately produced, narrow and bluntly pointed above.

Surface marked with very fine and close set concentric striations, which are scarcely visible without a lens; hinge teeth numerous, not very small; pallial impression undistinguishable.

Greatest length of the only specimen, about three and-a-half lines; height, from beaks to base, rather more than two lines; thickness through the valves, not quite one line and-a-half.

A solitary cast of a probably immature individual, with a small portion of the test preserved on one of the valves.

The posterior end of the present fossil is narrower, and more pointed above, than is the corresponding part of *Yoldia nasuta*, and at present

* "Palæontology of California," Vol. I., page 190. Plate XXV., fig. 178, and Plate XXXI., fig. 262.

this is almost the only difference that can be detected between the two shells. At the same time only one example of each has yet been collected, so that there is not sufficient material for a critical comparison. *Y. nasuta* was originally described from "a single specimen in the collection of the Californian Academy of Sciences, labelled Los Angeles." In Vol. II. of the "Palæontology of California," Mr. Gabb makes the "unqualified statement" that the species is undoubtedly Tertiary," but expresses a doubt of the correctness of the locality on the label. If the writer of these pages is not misinformed, the Californian Academy has in its possession a collection of fossils from the same part of the Queen Charlotte Islands as that visited by Mr. Richardson, and there is a bare possibility that the two fossils may have been obtained from the same district. Mr. Gabb's assertions that the lithological characters of *Y. nasuta* "place it outside of all the known Cretaceous, and that its geological horizon is probably either Miocene or Post Pliocene, are, however, by no means in favour of this hypothesis.

NUCULA. (Sp. undt.)

A cast of the right valve of a moderately convex, ovately triangular species of *Nucula*, with the anterior (and longer) side partly broken off. The impressions of the numerous anterior teeth are very clear and well defined, so that there is no doubt to what genus the shell belongs, but its specific peculiarities are entirely unknown.

CUCULLÆA (?) (Sp. undt.)

Two broken and water-worn casts of a large, elongated and very ventricose species of *Cucullæa* (?) with tumid and very prominent beaks, which are placed a little in front of the centre of the hinge line. It differs materially in shape from a shell which is abundant in the Cretaceous rocks of Vancouver and Sucia Islands, and which seems to be identical with the *Cucullæa truncata* of Gabb. The latter species, and perhaps both, scarcely belong to Lamarck's genus *Cucullæa*, as recently re-defined, but have more of the character of *Trigonoarca*, Conrad.

MODIOLA. (Sp. undt.)

Shell elongated, narrowly oblong, slightly curved; very ventricose, thickest in the direction of a line which might be drawn from the upper part of the beaks to the base of the posterior end. Superior border,

very gently arched or broadly rounded; basal margin concave in the middle and convex behind; anterior end obliquely subtruncate below the beaks, narrowest towards the base; posterior extremity ——— ? beaks terminal, obtuse. The test happens to be removed from the hinge area, and on the cast the superior border of both valves is obtusely carinate, each keel having a concave groove along its inner face. These carinæ and grooves extend the whole length of the hinge, and define an elongated, lanceolate, escutcheon-like depression.

Surface marked by close set, and regular, raised, concentric striations

Estimated length of the most perfect example, about three inches and two lines; actual height, in the middle, one inch and two lines; maximum convexity, one inch and four lines.

There are two specimens of this species, one of which has most of the thin test preserved on the left valve, though not on the right, while the beaks and a small piece of the posterior end are broken off. The other consists only of the anterior half of a cast of both valves, with a very small fragment of the test attached; but this specimen shows the shape and position of the beaks. The muscular and pallial impressions are not visible in either.

In *Modiola major* of Gabb,* the beaks are not terminal, and the surface is marked by coarse, distant and irregular lines of growth, but the general shape of that shell is otherwise very like that of the present fossil. Although probably new to science, the two mutilated specimens yet obtained are insufficient to show the full characters of the species. If the generic name *Volsella* of Scopoli is, as some writers assert, exactly synonymous with *Modiola*, Lamarck, the former name has long priority. The point being still somewhat doubtful, it has been thought best to retain a name sanctioned by long usage.

### Aucella Mosquensis? Von Buch.

Plate X., figs. 3, 3*a*.

For the synonymy of European examples of this species, see Eichwald's "Lethæa Rossica," Vol. II., pp. 519, 520.

Probably = Aucella Piochii Gabb. "Palæontology of California," Vol. I., page 187, Plate XXV., fig. 173, and Vol. II., pages 194 and 247, Plate XXXII, figs. 92, *a. b. c.*

Shell moderately convex, obliquely obovate, narrowest in the umbonal region. Anterior side very short, somewhat truncated; posterior side

* "Palæontology of California," Vol. II., page 191 Plate XXXI., fig. 88

much longer, its margin rather narrowly rounded; base broadly rounded, most projecting in the middle, Hinge border, behind the beaks, almost straight and horizontal: hinge area flattened at a right angle to the sides of the valves, or a little concave. There is no defined escutcheon, although the beaks are subcarinate behind, in consequence of the distortion which the specimen has undergone. Ligament external, large and prominent, extending along most of the length of the hinge line. Beaks large, anterior, terminal, curved inwards and forwards. At the anterior end, immediately under the beaks, there is a deep inflection of the margin of each valve, and an ovately cordate sinus is thus formed by the junction of two sunken auricles, as represented at Plate X., fig. 3*a*. The inflection is probably of the nature of a byssal emargination, though no actual opening can be detected between the valves at this point. The inner faces of the sinus are perpendicular, and the auricles are flattened at a right angle to the sides of the shell. Surface of the test concentrically costate; the ribs rather fine, and narrower than the grooves between them.

Greatest length, about two inches; height, in the middle, one inch and nine lines; maximum convexity, eleven lines. The greatest diameter of the only specimen is in the direction of a line drawn obliquely from the beaks to the posterior end of the base. The shell is preserved on the whole of the right valve, and on part of the left. The sculpture is not very well shown, but there are no traces of any radiating striæ.

The above description is intended to apply exclusively to the curiously distorted fossil represented on Plate X. In this specimen, (the only one collected) the general direction of the compression appears to have been lateral, but also a little oblique, so that the valves have been partially displaced. The beak of the right valve, accordingly, projects somewhat beyond that of the left, and the left valve is quite as flat, if not flatter, than the right. It is scarcely necessary to add, that in the normal state the left valve is much the most convex of the two, and that its beak overhangs that of the right. The elongated shape of the sinus under the beaks, and the blunt ridges behind them, are also obviously due to the compression just described.

In 1875, Mr. G. M. Dawson collected about fifty or sixty well preserved casts of an *Aucella*, which is undoubtedly the *A. Piochii* of Gabb, at Tatlyaco Lake,* in British Columbia. A careful study of these

* Tatlyaco Lake is on the east branch of the Homathco River, which empties into Bute Inlet. In some maps it is spelt Tatlahco or Tatlayoco.

fossils has led to the following conclusions:—1st, that the distorted *Aucella* from the Queen Charlotte Islands, also belongs to Mr. Gabb's species, and secondly, that *Aucella Piochii* itself is most probably conspecific with the European *A. Mosquensis*, that is, if Eichwald's synonymy is to be trusted. The writer has not access to the volume of Leonhard and Brown's "Neues Yahrbuch," in which *A. Mosquensis* was first described, nor has he been able to see any European examples of the species; but some of Mr. Dawson's best specimens almost exactly correspond with the *Avicula Fischeriana*, as figured and characterized in the "Palæontology of Russia," which latter shell is admitted to be the same as *A. Mosquensis*.

According to Mr. Gabb, *Aucella Piochii* is "very characteristic of a series of shales of the Shasta Group, found from Mount Diablo, at various points along the east face of the Coast Range, to the north end of the Sacramento Valley. Two or three good specimens from Washington Territory, east of Puget Sound, were presented by Mr. Samuel Hubbard to the California Academy of Natural Sciences. In Colusa County, east of Clear Lake, I found this shell forming almost the entire bulk of some beds, interstratified with the white limestones." At Tatlyaco Lake the rock is also largely made up of casts of this species, apparently to the exclusion of every other fossil; in the Queen Charlotte Islands it seems very rare. In Mr. Richardson's 1872 collections from Vancouver Island, there are two specimens of *A. Piochii* labelled "from loose pieces near Victoria," and Mr. G. M. Dawson has recently found another example in a boulder on the same island.

*Aucella Mosquensis* has been recorded from many localities in the northern part of the Russian Empire, and, according to Nordenskiold,* it occurs also at Spitzbergen. It appears to have been a gregarious mollusk, and is often met with in considerable numbers. Eichwald states that on the margins of the River Jauza, in the city of Moscow, there are banks of shells composed almost entirely of this species. Its exact geological horizon has been the subject of much discussion, and is still doubtful. In the "Geology of Russia," (1845) D'Orbigny says that it is characteristic of the "étage Oxfordien." Eichwald, in the "Bulletin de la Société Impériale des Naturalistes de Moscou for 1861 and 1862," and later in the "Lethea Rossica, 1867," Vol. II., page 520, places it in the Upper and Lower Neocomian. Writing in 1864 and

* "Sketch of the Geology of Spitzbergen." By A. E. Nordenskiold. Translated from the "Transactions of the Royal Swedish Academy of Sciences, Stockholm, 1867."

1865, Trautschold* claims that *A. Mosquensis* is a Jurassic fossil, possibly of the horizon of the Kimmeridge clay, though in a paper entitled "Die Schiedelinie Zwischen Jura und Kreide in Russland,"† dated 1875, the same writer is inclined to place it a little higher in the series, and to make it of about the age of the Portland Oolite. A conclusion similar to the one last cited had been arrived at by Rudolph Ludwig‡ in 1874, who expressed the opinion that one of the varieties of *A. Mosquensis* at least is a Tithonic form.

Eichwald§ thinks that *Aucella Pallassii* Keyserling, *A. concentrica* Fischer, *A. crassicollis* Keyserling and *A. Caucasia* Von Buch, are only varieties of *A. Mosquensis* based upon slight and unimportant differences in sculpture and external shape. The correctness of this opinion has not been disputed, but it is interesting to observe that while the surface of the test of the whole of these nominal species is concentrically striated, that of *A. Pallasii* and *A. Caucasia* is marked also with more or less distinct radiating lines.

In the "Proceedings of the Californian Academy of Sciences for 1864," Mr. Gabb described a fossil from the auriferous slates of the Sierra Nevada, on the Mariposa estate, as *Lima Erringtoni*. Mr. Meek|| not only regards this shell as an *Aucella*, but says that it "is so nearly allied to the *A. Pallasii* of Keyserling," that he "would not be surprised if they should prove to be identical when direct comparisons can be made." The Californian shell has radiating as well as concentric striæ.

D'Orbigny and Eichwald have both noticed the remarkably close resemblance which exists between casts of *Aucella Mosquensis* and *Inoceramus concentricus*, and there is just the same similarity between American examples of the latter shell and *Aucella Piochii*. It happens that *Inoceramus concentricus* is rather abundant at the Queen Charlotte Islands, also, that the specimens are only well-preserved casts; and it is by no means easy to distinguish these from the *Aucellæ* from Tatlyaco Lake. On the right valve of the casts of the *Aucellæ* there is generally an oblique and deeply-channelled groove immediately under the beaks, caused by the sudden inflection of the valves at this point, and this is always absent in the Inocerami. Still, it is scarcely possible to discriminate between casts of very young examples of the two species.

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* "Zeitschrift der Deutschen Geologischen Gesellschaft, Berlin." Vol. XVI., pages 584—94, and Vol. XVII., pages 448—456.

† "Bulletin de la Société Impériale des Naturalistes de Moscou." Vol. XLVIII., page 150.

‡ Idem., Vol. XLVIII., pages 373-80.

§ "Lethea Rossica," Vol. II., page 523.

|| "Geology of California," Vol. I., pages 479-80.

If the supposition that *Aucella Piochii* is merely a synonym of *A. Mosquensis* should prove to be well founded, the species has a very wide geographical distribution, and a somewhat extended range in time. *A. Erringtoni* may also be only another variety of this protean shell.

### Meleagrina amygdaloidea, (N. Sp.)

Plate X., fig. 4.

Shell inequivalved, left valve moderately convex, the right slightly flatter; outline broadly elliptic-oval; height about one-third greater than the length. Beaks rather small, curved forwards and downwards, placed a little in advance of the centre of the valves. Escutcheon linear lanceolate, subcarinate at the margin, filled up, except at the extreme ends, by the thick ligament which projects above it in the centre. Hinge border wingless, convex near the beaks, then sloping obliquely and rapidly downwards. The posterior margin is broken, but it appears to have been straight, and it forms a subangular junction with the hinge line above. Anterior margin descending obliquely and widening outwards in a shallowly concave curve which extends from the beaks to a point opposite to the termination of the hinge line behind; very slightly convex in the middle. The base, together with a small portion of the lower part of the two sides, has almost exactly the shape of the widest end of a broad ovoid.

The surface of the test, which is very imperfectly preserved, appears to be marked with faint, distant and rather irregular concentric striæ, or plications.

Height, two inches and six lines; length, one inch and nine lines; thickness, allowing for a part of the shell which is wanting on one valve, one inch.

A single specimen, with the posterior margin broken, but which shows the large external ligament, and the test composed of an outer, fibro-prismatic layer, and an inner nacreous lining; a combination of characters almost peculiar to the Aviculinæ.

On the whole, this wingless Avicula is probably a rather aberrant species of the Lamarckian genus *Meleagrina*, but it may prove to be the type of a new sub-section. It is true that the shortness of the hinge suggests affinities with *Pseudoptera*, as recently re-defined by Meek,* but

* "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." Washington: 1876. Page 29.

the shape of the present shell is not so oblique, and its valves are not so decidedly unequal in convexity as in typical examples of that sub-genus.

*M. amygdaloidea* seems congeneric with a fossil from the Cretaceous rocks of Vancouver Island, described by Mr. Gabb * as *Meleagrina antiqua*. The differences between the two species are, however, tolerably clear. In *M. antiqua*, the height is not much greater than the length, the beaks are terminal, and the hinge line is straight and almost horizontal. In *M. amygdaloidea*, the height greatly exceeds the length, the beaks are sub-central, and the hinge margin is convex and very oblique.

### Inoceramus concentricus, Parkinson.

Inoceramus concentricus, Sowerby. "Mineral Conchology," Vol. III., page 183, Plate CCCV.

Inoceramus concentricus, Goldfuss. "Petrefactæ Germanicæ," Vol. II., Plate CIX. figs. 8*a*—*c*, but *not d* and *e*.

Inoceramus concentricus, D'Orbigny. "Paléontologie Française, Terrains Cretaces," Vol. III., page 506, Plate CCCCIV.

Inoceramus concentricus, Pictet. "Traité de Paléontologie," Atlas, Plate LXXXII., fig. 18.

Twenty-five specimens of an Inoceramus, apparently referable to a single species, were collected by Mr. Richardson at three localities. Twelve are from the lower shales of Maud and Lina Islands; five from rocks of the same horizon on the shores of a small bay south of Christie Bay; and eight from the upper shales on Graham Island, about three miles to the north-east of the village of Cowgitz. They are the only fossils procured from the two last-mentioned localities, which are indicated on the map by the letter F.

Eight of the examples from Maud and Lina Islands are sufficiently perfect and undistorted to enable them to be identified with some certainty as the *Inoceramus concentricus* of European authors. Although nothing more than tolerably perfect casts, the obovate outline, the convexity of the left valve, with its prominent and semi-spiral beak, and the flatter and smaller right valve, so characteristic of *I. concentricus*, are very clearly shown. These undistorted fossils vary both in shape and sculpture; oblique specimens, which are regularly costate, might have served for the originals of Goldfuss' figures; while others, again, with a more nearly equilateral contour and irregular concentric striation, correspond better with the illustrations of D'Orbigny and Pictet.

* "Palæontology of California." Vol. II., page 192, Plate XXXI., fig. 89.

Four of the *Inocerami* from Maud and Lina Islands, and all from the other localities, are either so imperfect or so much crushed out of shape that it is impossible to determine satisfactorily to what species they belong; still, as stated above, it is most probable that they are all *I. concentricus*.

*I. concentricus* is abundant in the Cretaceous rocks of many localities in Europe. It is most characteristic of the Gault, but is found also in the Upper Greensand. It has not yet been recorded as occurring on the mainland of North America.

The species was first described by Parkinson in Vol. V. of the First Series of the "Transactions of the Geological Society of London, 1820," but a reference to the original description is purposely omitted above, because the writer has not had the opportunity of consulting it.

### MELINA MYTILOIDES (?) (Lamarck. Sp.)

Perna mytiloides, (?) Lamarck. "Animaux sans Vertèbres." Second Edition. Vol. VII., page 79.

Perna mytiloides, (?) Damon. "Supplement to the Geology of Weymouth and the Island of Portland," Plate II., fig. 5.

Perna mytiloides, (?) Phillips. "Geology of Oxford and the Valley of the Thames," Plate XV., fig. 5.

FIG. 8.

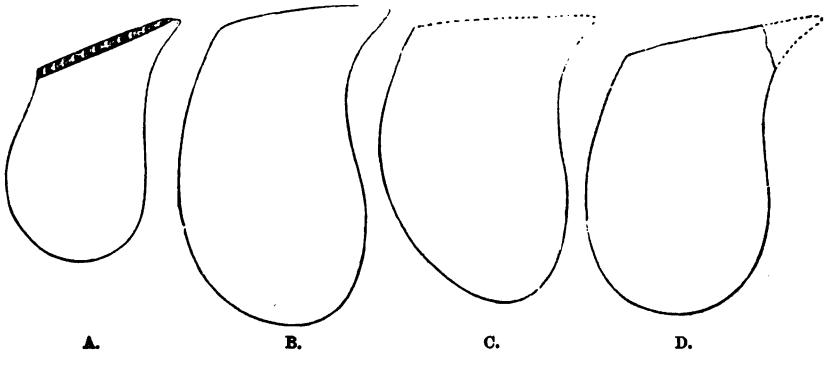


FIG. 8.—A, B, C, D.—Outlines of four specimens of *Melina mytiloides* (?), about one-third of the natural size. The original of fig. A, though little more than half grown, is the only one in which the hinge and beaks are perfect; in fig. C, the lower half of the shell is entire; the other two are partly restored from the lines of growth.

Shell nearly equivalved, compressed, thickest near the anterior margin; general outline elliptic-ovate, obliquely truncate above; height much

greater than the length. The shape varies in different individuals, and the variation of the contour can be best expressed by a separate description of each part.

The hinge line is usually straight and oblique, but the amount of obliquity is greater in some specimens than in others. In fig. A, the maximum of obliquity is reached; in figs. C and D, the hinge line is more nearly horizontal; and in fig. B, it was probably a little convex. There are between ten and twelve cartilage pits in the hinge, and these sometimes, though not always, are narrowest at the posterior end.

The beaks are slender, elongated and terminal; they are unequal in size and of a different shape, but both project considerably beyond the anterior margin. As viewed from above, the beak of the right valve curves decidedly outwards from the hinge line at a short distance from the apex, and then turns rather suddenly inwards and almost backwards. The beak of the left valve is straight, and points forwards, the extreme tip being bent slightly downwards. The anterior margin is usually shallowly concave from the beaks to about the middle, so that the two sides of the upper half of the shell are almost exactly parallel. In some specimens, the concavity of the margin in the region of the byssal opening does not quite extend to the middle. Beneath the centre the anterior border generally widens a little, and becomes gently convex, but occasionally it is almost straight. The front margin, as a whole, has the shape of a sigmoid curve, but this is sometimes almost straightened out. In some examples, the shell is as wide or wider below than above; in others it is narrowest below.

The byssal orifice is well shown in two or three instances. Below the beaks, in front, the edge of the left valve projects slightly beyond that of the right, and between both there is a long but very narrow opening.

The shape of the posterior margin is very variable in different specimens. In some it is almost straight and perpendicular; in others, it is rather oblique above the middle, and gradually widens and becomes decidedly convex below; but in every case it forms an angular junction with the hinge line above. The base is either evenly and narrowly rounded, or else it is produced and somewhat pointed in front of the middle.

The surface is marked apparently by irregular and, for the most part distant, concentric striæ, but the test is exfoliated in all but a single specimen, and on this there is only a small portion of the outer layer preserved.

Height of the largest example (fig. B), about five inches from hinge to base; approximate length of ditto, two inches and seven lines; thickness through the valves, one inch and four lines.

Ten specimens were collected, some of which are very imperfect.

It has been thought desirable to give figures and a description of these fossils, for although the writer has failed to find a single character by which they can be satisfactorily distinguished from the *Perna mytiloides* as figured by Mr. Damon and the late Professor Phillips, he is by no means convinced that they belong to that species. The Lamarckian definition of *P. mytiloides* ("P. testâ ovato-oblongâ, depressâ, basi acutâ; cardine obliquâ) is altogether insufficient for the discrimination of closely related forms.

The generic name *Melina* of Retzius has priority over *Perna*, Bruguiere.

SYNCYCLONEMA MEEKIANA. (N. sp.)

FIG. 9.

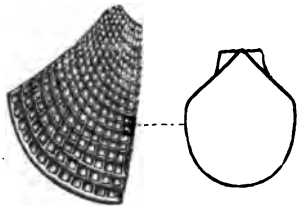

FIG. 9.—SYNCYCLONEMA MEEKIANA.—Outline of an immature but nearly perfect example, with a portion of the test of another specimen magnified to show the details of the sculpture The engraver has not made the tubercles which result from the crossing of the ribs sufficiently distinct.

Shell small, compressed, thin; subovate when half grown, but nearly orbicular when adult; often triangular above the middle. The ears are imperfect in all the specimens; but in the upper valve they appear to have been horizontal above and almost vertical at the sides; those of the lower valve are unknown.

The surface of the main body of the shell is marked by very numerous, fine and closely-arranged, rounded concentric ribs, which are crossed by exactly similar radiating costæ. The points at which the radiating ribs pass over the concentric ones are marked by small rounded elevations or tubercles, which give a nodose appearance to the sculpture, but which are too small to be visible to the naked eye. The wood-cut does not give a very good idea of these. Sculpture of the ears unknown.

Out of about twenty specimens of this little Pecten, only one shows the peculiar nodosely-cancellate sculpture which forms one of the best distinctive characters of the species; the rest are all exfoliated.

At first sight S. *Meekiana* might easily be confounded with the *Pecten Rogoznicensis* of Zittel,* but a closer comparison will show important differences in the sculpture of the two shells. In *P. Rogoznicensis* the relatively coarse radiating ribs cut through the finer and more delicate concentric costæ, and accordingly there are no tubercles or swellings at the point of contact.

The surface markings of *Pecten nodoso-cancellata* Eichwald, † as the name suggests, are still more like those of *S. Meekiana*, but the narrowly spathulate shape of the Russian shell will at once enable it to be recognized.

The species is dedicated to Mr. F. B. Meek, of Washington, one of the most industrious and accurate of American palæontologists, and the author of the sub-genus to which it belongs.

### Ostræa. (Sp. undt.)

Three single valves of a species of *Ostræa*, two of which are so much exfoliated that they only show the general outline of the shell, which is what would generally be called long and narrow, but the elongation is in the direction of the height, which is nearly twice the length. Their contour, too, is irregular, being somewhat dilated below the middle. The third specimen is broadly sub-triangular, the narrowest part being near the beaks; the test is very thick. The characters of the three collectively, are rather like those of the *Ostræa Leymerii* of Deshayes, a French Upper Neocomian fossil.

## BRACHIOPODA.

### Terebratula (?) (Sp. undt.)

Shell subovate or suborbicular, usually a little pointed both above and below. In the adult the length is greater than the width, but in half-grown individuals the opposite is the case. Pedicelled or neural valve without any definite umbonal ridge, but convex in the middle, and

* "Die Fauna der Aelteren Cephalopoden Fuehrenden Tithonbildungen," page 241, Plate XXXVI., figs. 23, *a*, *b*.

† "Lethea Rossica," Vol. II., page 445. Atlas, Plate XX., figs. 11, *a*, *b*

obliquely compressed at the sides; brachial or hœmal valve much the flattest of the two. The beaks are partly broken in each specimen, but the foramen was undoubtedly large: the size and shape of the deltidium cannot be ascertained. Front of the valves almost straight, or, at any rate, not distinctly sinuous.

The test is exfoliated in every case, but there is clear evidence that the surface was marked with rather distant concentric striæ, and in one specimen at least with fine and close set radiating lines. The punctate character of the shell is also plainly visible with a lens. Length of the largest example, two inches and two lines; width, twenty-three lines; maximum convexity twelve and a half lines.

The species is represented by three broken and badly preserved specimens, which have very much the aspect of *T. depressa*, Lamarck, and *T. subdepressa*, Stoliczka, as represented in the "Palæontologia Indica,"* but they are too imperfect to be identified with much certainty.

### Terebratula (?) (Sp. Undt.)

A small specimen of possibly another species of *Terebratula*, but in very bad condition, and partly buried in the matrix. It has a more convex hœmal valve than the shell last described, and a much smaller foramen.

## ANTHOZOA.

The only coral collected is so much water worn that its generic position is doubtful.

## ADDITIONS AND CORRECTIONS.

### Nautilus, Sp. Undt. (Pages 14–19.)

The remarks under this heading were written in 1875, before the publication of the "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." In that very useful work, Mr. Meek expresses an opinion that the *Nautilus elegans* of Sharpe is probably identical with *N. elegans* of Sowerby, but that *N. elegans*, D'Orbigny, is perhaps distinct. With all due deference to Mr. Meek's judgment, the writer can scarcely see his way clear to accept the first of these conclusions. Sharpe's description and figures of *N. elegans* do not accord at all well with those of the type in the "Mineral Conchology," yet no reasons are given to account for a discrepancy which, it is thought, must have been obvious if the two forms had been compared directly.

* Vol. IV. pp 16, 17. Plate II., and Plate III., figs. 1–8,

The Sucia Island fossil agrees almost exactly with Meek's diagnosis of the American shell figured as *N. elegans*, but the former is rather the most compressed of the two.

ACTÆON, Sp. undt. (Page 53.)

Six specimens were described under this name, which probably belong to two species, perhaps even to different genera. Two of those have a narrowly cylindrical shape like that of *Actæon attenuata*, Meek, * the others a swollen body whorl and a very short spire, much as in *Pseudobuccinum Nebrascense*. † Another specimen of the short inflated form has recently been obtained by breaking up small pieces of rock from the Queen Charlotte Islands, and this has part of the test preserved. Under the microscope the sculpture is seen to consist of flattened revolving ribs, with nearly perpendicular sides, separated by grooves of nearly equal width, both of which are crossed by fine, transverse, raised striæ. *Ringuicula varia*, Gabb, ‡ from the Chico Group of Cow Creek, Shasta County, California, has exactly the same surface markings, but it has a more elongated spire than the present species, and has five or six whorls instead of three.

ERRATA.

Page 7, line 12 from the bottom. For "*rarely*," read "*barely*."
Page 21, line 7 from the bottom. For "*seem*," read "*seems*."
Page 24, line 6 from the top. For "*Plate III., fig.* 3," read "*Plate III., fig.* 1."

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* "Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," page 281. Plate XIX., figs. 17, *a. b.*

† Idem, page 350. Plate XXXI., figs. 5, *a, b, c, d.*

‡ "Palæontology of California," Vol. I., page 112. Plate XXIX., figs. 222, *a. b.*

## CONCLUSION.

In Europe, where the succession of the Mesozoic rocks has been traced out in more minute detail than in North America, and where the animal life of the age is better known, it is found that its marine fauna is continuous throughout, with only local exceptions. The Rhætic beds hold fossils which pass from the Trias into the Lias, and M. Ernest Favre has shown that the Jurassic and Cretaceous strata of the Alps are not separated, as in the Anglo-Parisian basin, by fresh water deposits. In 1865, Prof. Oppel, of Munich, proposed the name of the Tithonic Group for certain rocks which occur in Spain, Italy, Switzerland, Austria, &c., and which were then believed to be the equivalents of the Portland Oolite and Purbeck beds of England. Still later, Dr. Neumayr has suggested the division of this group into an Upper and a Lower series. It is by no means certain that the Upper Tithonic strata are exactly synchronous with the English Purbecks, but it is tolerably clear that the former represent the extreme top of the Jurassic Series as understood by European geologists. The Upper Tithonic deposits are beds of passage between the Jurassic and Cretaceous, and contain a small percentage of marine fossils which pass upwards into the Lower Neocomian. *Aucella Erringtoni*, from the auriferous and presumably Jurassic slates of the Sierra Nevada, may be identical with the *A. Piochii* of the Shasta Group of California, but, with this exception, no fossil is known to be common to the Jurassic and Cretaceous formations in America.

A different classification of the Cretaceous rocks is adopted in two of the most popular and recent hand-books of geology. Professors Jukes and Geikie* recognize only an Upper and a Lower Cretaceous group, and place the Wealden at the base of the latter. In the second edition of Prof. Dana's "Manual of Geology," dated 1874, the period is divided into Upper, Middle and Lower Cretaceous, while the Wealden is regarded as a separate epoch, belonging to the upper part of the Jurassic. As Prof. Dana's manual is universally used in America, it will be more convenient to adopt his arrangement.

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* "The Student's Manual of Geology." By J. Beete Jukes, M.A., F.R.S. Third Edition. Edited by Archibald Geikie, F.R.S. Edinburgh: 1872.

It should be premised, also, that an opinion is gaining ground that sedimentary deposits which contain fossils of exclusively land or fresh water origin, such as the Purbecks and Wealden, should be tabulated in a separate series from the purely marine strata, and not intercalated between them.*

The collection obtained by Mr. Richardson is remarkable for the almost total absence of those genera which are restricted to a single epoch, and the fossils for the most part are strikingly unlike those of any known division of the Mesozoic age in America.

The following is a synoptical list of the species, arranged in zoological order:—

| | Total No. of Species. | Unrecognizable. | New. | Previously described. |
|---|---|---|---|---|
| Cephalopoda ..... | 14 | 3 | 8 | 3 |
| Gasteropoda ..... | 6 | 4 | 2 | 0 |
| Lamellibranchiata ... | 22 | 12 | 7 | 3 |
| Brachiopoda ..... | 2 | 2 | 0 | 0 |
| Anthozoa ..... | 1 | 1 | 0 | 0 |
| | 45 | 22 | 17 | 6 |

Including the shells referred doubtfully to *Scalaria Albensis* and *Melina mytiloides*, twenty-two of the above are represented by such imperfect specimens that the species, and in some cases even the genera, cannot be determined with any precision. A few are probably new to science, but they are not in a satisfactory condition for description. Of the remainder, seventeen are now described and figured for the first time, while six belong to forms which have been named and characterized by other writers.

It has already been stated that these invertebrates present "an apparent mixture of Oolitic and Cretaceous types," and this opinion is based upon the following facts:—

Five of the new species, and three of the doubtful forms, bear a suggestive, but, at the same time, only a very general resemblance to European Oolitic fossils, which may be thus expressed:

*See Prof. J. Young's Address before the Geological Section of the British Association for the Advancement of Science, at Glasgow, 1876.

| Queen Charlotte Islands. | Analogies to European types. |
|---|---|
| Ammonites Richardsonii ..... | Nearly related to A. coronatus, Brug. from the "Callovien" of France. |
| A.Skidegatensis & A.Carlottensis | Of the type of Perisphinctes tyrannus Neumayr, and allied to several of the Oolitic Planulati. |
| A. Loganianus forms A. & B. ... | More like the Oolitic than the Cretaceous Macrocephali. |
| Pseudomelania (?) Sp. Undt.... | Scarcely to be distinguished from P. Heddingtonensis. |
| Actæonina (?) Sp. Undt..... | A genus most characteristic of the Oolitic epoch. |
| Pleuromya Carlottensis..... | The ribbed Pleuromyæ do not appear to range upwards into the Cretaceous, but this shell may be a Panopœa. |
| Melina mytiloides? Lam. Sp. .. | Very doubtfully referred to this Tithonic and Middle Oolite species. Quite likely both distinct and new. |

Further, a comparison of Mr. Richardson's collection with the fossils of the Tithonic formation of the Carpathians, Southern Alps and Central Apennines, as monographed by Zittel, reveals other, and perhaps closer correspondences, such as the following :—

| Queen Charlotte Islands. | European Tithonic. |
|---|---|
| Nautilus, Sp. Undt..... | Nautilus asper, Oppel. |
| Ammonites Perezianus ..... | Oppelia Waageni, Zittel. |
| " Richardsonii..... | Ammonites Groteanus, Oppel. |
| " filicinctus ..... | Lytoceras quadrisulcatum, D'Orb. |
| " crenocostatus ..... | " Liebigi, Oppel. |
| " Sp. (Nr. A. simplus D'Orb.)... | Aspidoceras cyclotum, Oppel, young. |
| Syncyclonema Meekiana..... | Pecten Rogoznicensis, Zittel. |

*Aucella Piochii*, Gabb, is probably the same as the *Aucella Mosquensis* of Von Buch, and the latter shell is either of Middle or Upper Oolitic age in Europe, but in America *A. Piochii* is said to be one of the most characteristic Lower Cretaceous fossils.

On the other hand, what little direct and positive evidence is at present afforded by the fossils from the Queen Charlotte Islands is in favour of their being referred to the Cretaceous period. Six of the species from this region, whose names are given below, have been previously described from other localities and by different writers.

The whole of these are Cretaceous, unless, indeed, some of the members of the Shasta Group should prove to be of Upper Tithonic age, which is by no means improbable.

| Queen Charlotte Islands. | Original Localities and Horizons. |
|---|---|
| Ammonites Timotheanus, Mayor..... | Gault of Switzerland. |
| Inoceramus concentricus, Parkinson..... | Gault of England. |
| Ammonites Brewerii, Gabb..... | Shasta Group of California. |
| " Stoliczkanus, Gabb..... | " " " |
| Aucella Piochii, Gabb (?= A. Mosquensis). | " " " |
| Unio Hubbardi, Gabb ..... | Chico Group of Vancouver Island. (Probably an error.) |

The remainder belong, in many cases, to genera which originated in the earlier part of the Mesozoic age, and which are not yet extinct.

Mr. Gabb has divided the Cretaceous rocks of the west coast of America into the Shasta, Chico, Martinez and Tejon Groups, but the Martinez is now regarded as only a subdivision of the Chico Group. The "Shasta Group" is the oldest known member of the formation, the name being originally suggested for a series of beds which the same author believes to be the "equivalent, or at least the nearest representative of the Neocomian."* Next in order comes the "Chico Group," an accumulation of sediments of immense thickness, "which includes all of the known Cretaceous of Oregon, and of the extreme northern portion of California," † also the Coal-bearing formation of Vancouver Island. According to Dana,‡ the so-called "Martinez Group" of Mount Diablo, forms its uppermost subdivision. Lastly, the newest member of all is the "Tejon Group," which is supposed to correspond to the Maestricht beds of Europe, but which has not yet been recognized outside of California. Nearly the whole mass of the Cretaceous formation of the Pacific slopes is made up of the Shasta and Chico Groups, and Mr. Richardson estimates the thickness of the Vancouver Island deposits, which are believed to belong to the latter of these two divisions, at 5,000 feet.

* "Palæontology of California," Vol. II. Foot note to page 129.

† Idem. Preface, page xiv.

‡ "Manual of Geology." Second Edition. Page 457.

As three species of fossils are common to the Queen Charlotte Islands and to the "Shasta Group" of California, it will be curious to note whether there are any other points of resemblance between the known faunæ of the two localities. An analysis of the fossils of the Shasta Group, as catalogued in Vol. II. of the "Palæontology of California," gives the following results:—Crustacea, one species; Cephalopoda, nineteen; Gasteropoda, fifteen; Lamellibranchiata, eleven; Brachiopoda, one. The proportion of Cephalopoda to Gasteropoda in the Queen Charlotte Island collection is as fourteen to six, and there are no exclusively Cretaceous genera in any of the three classes of mollusca. In the Shasta beds there are nineteen species of Cephalopoda to fifteen of Gasteropoda, and the only exclusively Cretaceous genera or sub-genera are *Crioceras*, *Anisomyon*, *Thetis* and *Neithea*.*

The writer happens to have exceptionally favourable opportunities for a comparison between the invertebrata of the Coal-bearing rocks of the Vancouver and Qneen Charlotte groups. For the past five years, from 1871 to 1875 inclusive, Mr. Richardson has been engaged in a critical examination of the geology of the Nanaimo and Comox districts of Vancouver, together with that of many of the smaller islands of the Strait of Georgia. One of the results of his labours in this region has been the collection of an extensive and interesting series of fossils, consisting of about seventy or eighty species of mollusca proper, two of brachiopoda one cyclostomatous polyzoon, and a turbinolian coral. These have only been partly studied so far, but twenty-nine of the shells are identical with as many species which have been already described from these islands by Meek, Shumard and Gabb: about fifteen more are also conspecific with fossils either of the Chico Group of California or else of the Upper Cretaceous of Texas or New Jersey: the rest appear to be new. So far as the number of genera and species are concerned, Gasteropoda decidedly predominate over Cephalopoda in the Vancouver Cretaceous, and the same thing holds true with regard to rocks of the same age in other localities. Thus, in Mr. Gabb's catalogue of the fossils of the Chico Group from Oregon and California, † there are as many as forty-eight species of Gasteropoda to fifteen of Cephalapoda. In the Vancouver rocks each of the three divisions of the mollusca is represented by very characteristic Cretaceous genera, as in the following list:—

Cephalopoda. Baculites, Hamites, Heteroceras or Helicoceras.

---

* According to Stoliczka, *Vola* is an older name than either *Neithea* or *Janira*.

† "Palæontology of California," Vol. II., pp. 208—254.

Gasteropoda. Stomatia, Cinulia, Fulgoraria, Pleurotoma.

Lamellibranchiata. Axinæa, Acila, Conchocele, Thetis, and many kinds of Inoceramus.

The marine faunæ of the coal-bearing series of the Vancouver and Queen Charlotte Islands appear, therefore, to be entirely different, and as yet not a single species can be satisfactorily identified as common to both.

The preceding observations may be summarized or recapitulated as follows :—

1. That in Europe there are beds of passage which connect the marine deposits of the Oolitic or Upper Jurassic epoch with those of the Cretaceous, but that similar transitional strata have not yet been recognized in America.

2. That some of the Queen Charlotte Island fossils bear a considerable resemblance to European Oolitic types, but that this analogy is often of a very general character, and can scarcely in any case be shown to amount to actual specific identity.

3. That among the specimens collected by Mr. Richardson there are at least one or two species which are known to be Cretaceous: also, that the collection indicates a fauna much more like that of the Shasta Group of California and British Columbia than that of the coal-bearing series of Vancouver and the adjacent islands.

While, on the one hand, the fossils described in these pages show that the probable geological position of the beds which contained them is near the base of the Lower Cretaceous formation, or top of the Upper Jurassic, they are insufficient to mark the definite horizon to which the series should be referred. It is sufficiently obvious that they exhibit a blending of the life of the Cretaceous period with that of the Jurassic, and perhaps the best course would be to regard the Queen Charlotte Island series provisionally as merely one of the oldest members of the Shasta Group, until the organic remains of the beds associated together under that name are better understood.

The Carbonaceous shales near Cowgitz contain a *Unio* which can scarcely be distinguished from a Wealden species, and this circumstance, though it certainly seems to tend towards the establishment of a connection between the Queen Charlotte Island rocks and the Wealden of Europe, throws no light upon the exact age of the former. The Wealden is a purely local deposit, which by some writers is regarded as synchronous with the Lower Necomian, and by others as belonging to the

Jurassic formation. Prof. Dana places it (the Wealden) as a separate epoch, intermediate between the Oolitic and Cretaceous periods, but as has been before remarked, it should rather be correlated with one of the marine deposits of the Cretaceous or Jurassic.

At present it would be premature to express any very decided opinion on the exact age of these Coal-bearing rocks. All that the fossils show with any degree of probability is that the series can scarcely be much newer than the Middle Cretaceous, or older than the Upper Jurassic.

## *PLATE I.**

### BELEMNITES, Sp. undt. (page 11.)

Figure 1. Guard of the most perfect specimen yet obtained. See also wood-cut No. 1.

" 1 *a*. Phragmocone of another individual of the same species.

" 1 *b*. Outline of transverse section of the original of figure 1, near the apex.

" 1 *c*. Outline of transverse section of ditto, at the anterior or thickest end.

### AMMONITES BREWERII, Gabb (page 21.)

Figure 2. Side view of the largest example collected. Normal form, with faintly striated surface.

" 2 *a*. Outline of aperture of do. The sides are represented as too straight below, they should curve slightly inwards, from a little beneath the middle of the whorl, to its base.

" 3. Side view of a specimen of the dwarfed costate variety.

" 3 *a*. Outline of aperture of the same.

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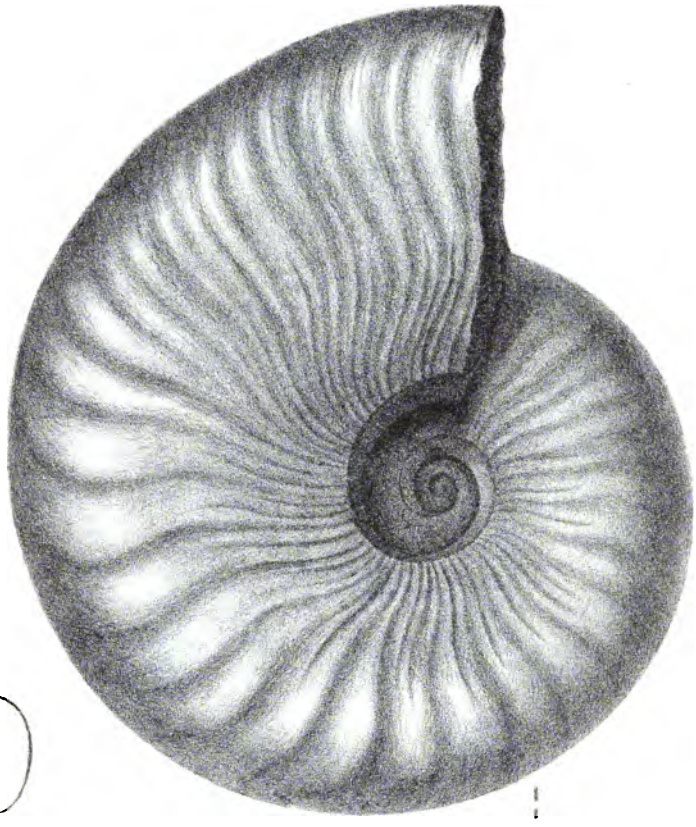
* Unless there is a distinct statement to the contrary, the figures in all the Plates are of natural size.

1.

1a

1b

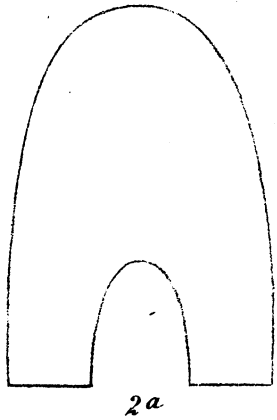
1c



2.

3.

3a



2a

A.H. Foord, del et lith.

Geo J. Gebhardt, imp.

# *PLATE II.*

## AMMONITES PEREZIANUS (page 19.)

Figure 1. Side view of the type specimen.

" 1 *a*. Outline of aperture of the same. The original being rather water-worn, the periphery is represented as too narrow, when perfect it is rather more broadly rounded. The emargination of the base, too, is not nearly deep enough.

## AMMONITES FILICINCTUS (page 43.)

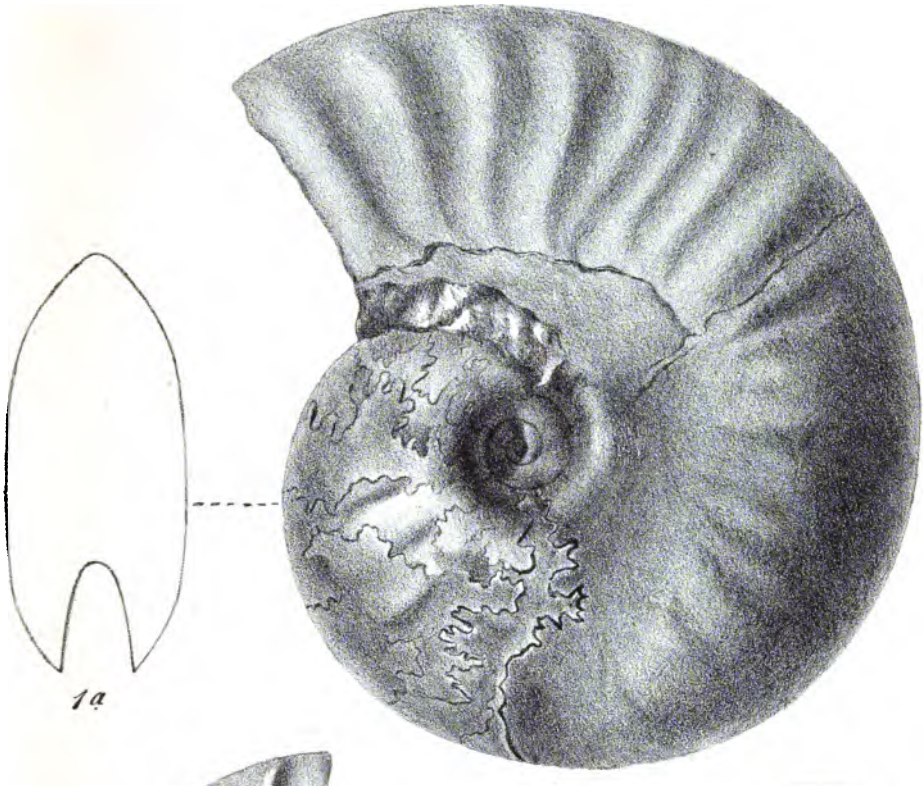
Figure 2. Side view of a small but very perfect individual.

" 2 *a*. Another representation of the same, to show the shape of the aperture and siphonal edge.

" 2 *b*. Section of do. The edges of the inner walls of the whorls are obliterated.

" 2 *c*. Portion of the test of do., magnified.

" 3. A larger specimen, partly restored.



1a

1.

2c

2.

3.

2b

2a

A.H. Foord del et lith.

Geo. J. Gebhardt, impt.

Non

## *PLATE III.*

AMMONITES STOLICZKANUS, Gabb, var. spiniferus. (page 24.)

Figure 1. Side view of a distorted and somewhat immature specimen.

AMMOMITES TIMOTHEANUS, Mayor. (page 41.)

Figure 2. A small but perfect example.

" 2 *a*. Another view of the same.

AMMONITES LAPEROUSIANUS (page 39.)

Figure 3. The largest of the two specimens.

AMMONITES, Sp. undt. Near *A. Simplus*, D'Orb. (page 47.)

Figure 4. Side view.

" 4 *a*. Front do.

1.

4a.

4.

3.

2a.

2.

A.H. Foord, del et lith.

Geo. J. Gebhardt, Ottawa.

## *PLATE IV.*

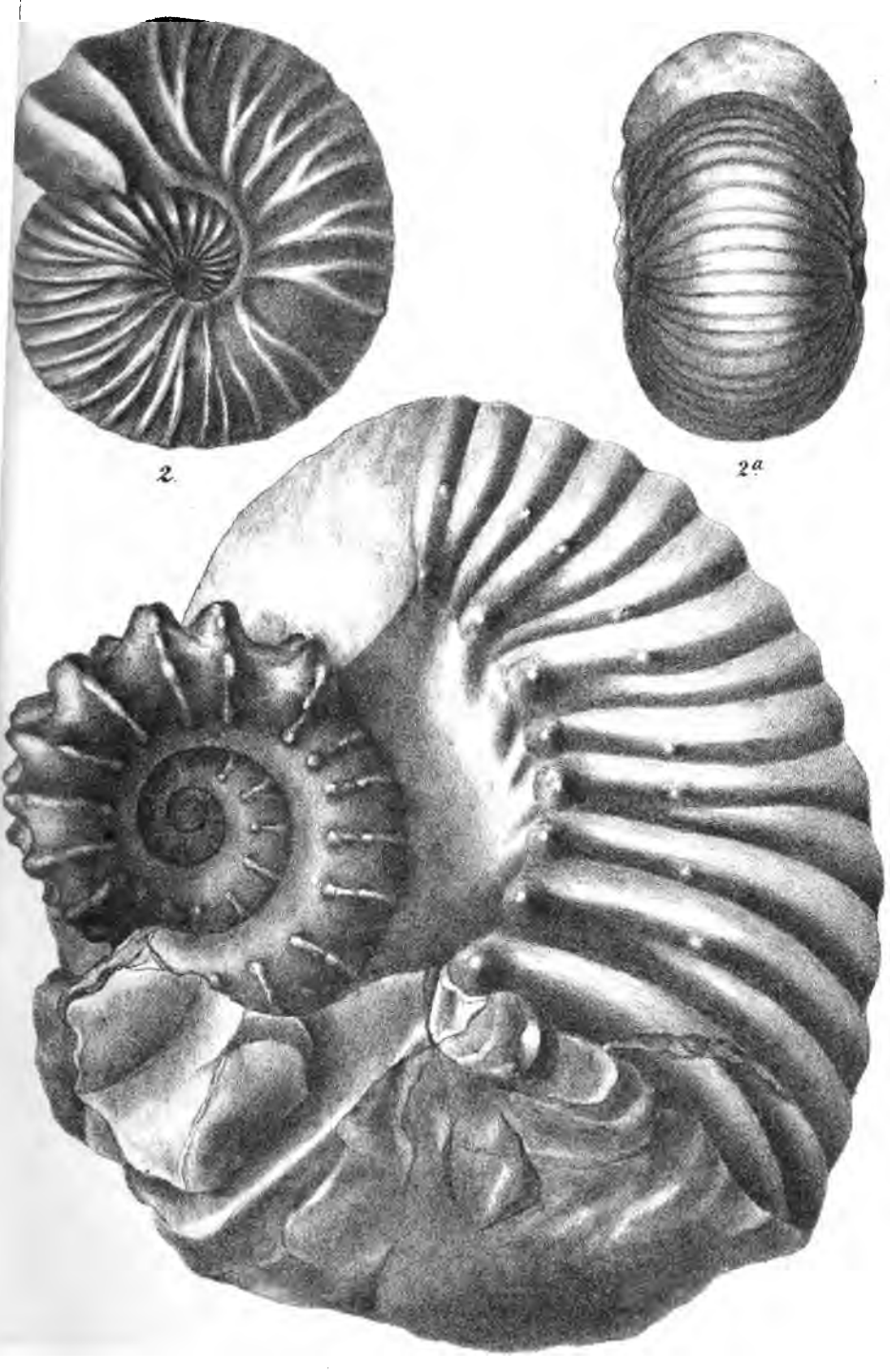
AMMONITES STOLICZKANUS, Gabb, var. spiniferus (page 24.)

Figure 1. A broken but nearly adult example, drawn in such a position as to show the depth and abrupt truncation of the inner edge of part of the body whorl.

AMMONITES LOGANIANUS. Form A. (page 29.).

Figure 2. Side view of the only specimen in the collection.

" 2 *a*. Front aspect of the same.



2.

2a

1.

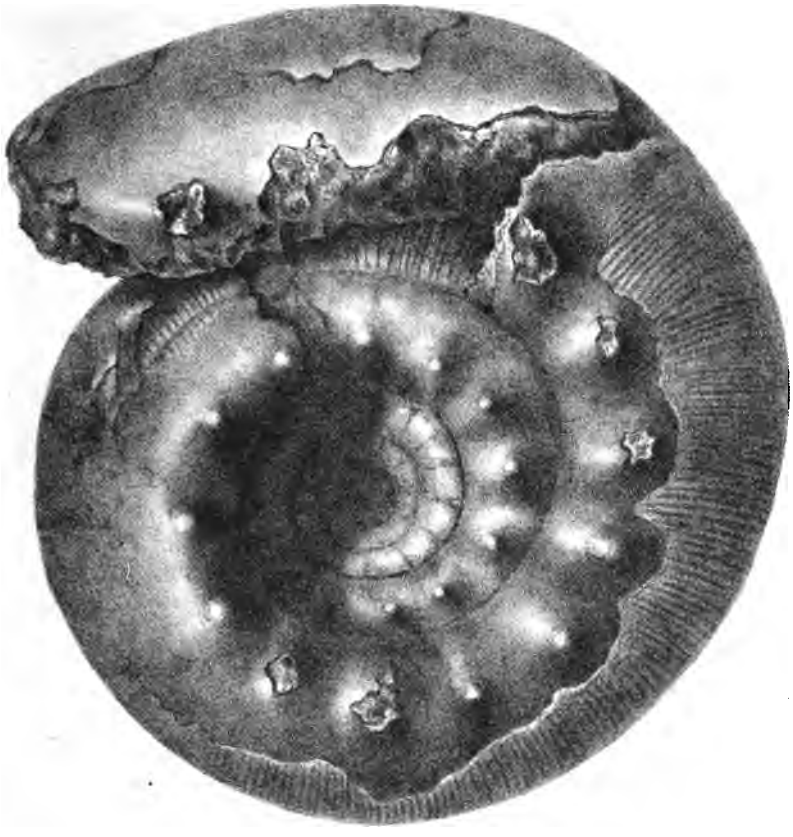
## *PLATE V.*

AMMONITES RICHARDSONII (page 32.)

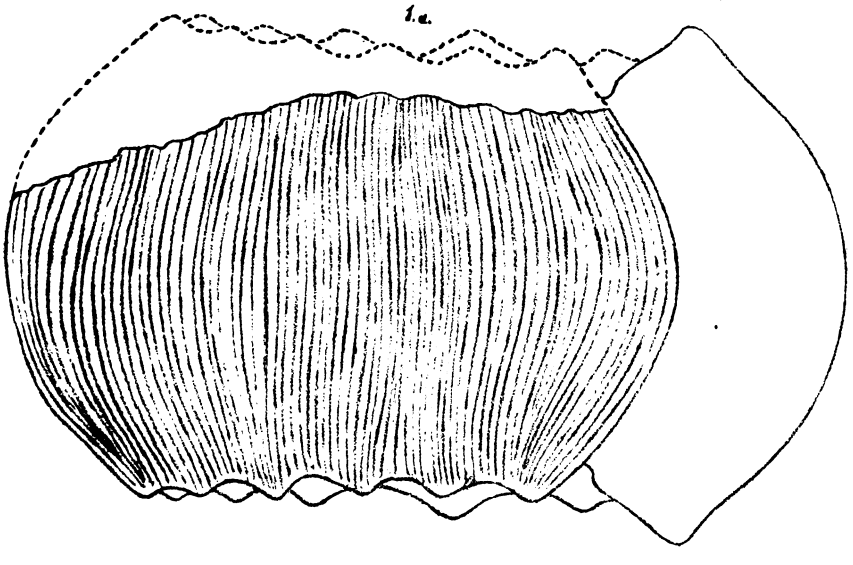
Figure 1. View of the most perfect side of the type specimen.

" 2. Front of do. partly restored.

1



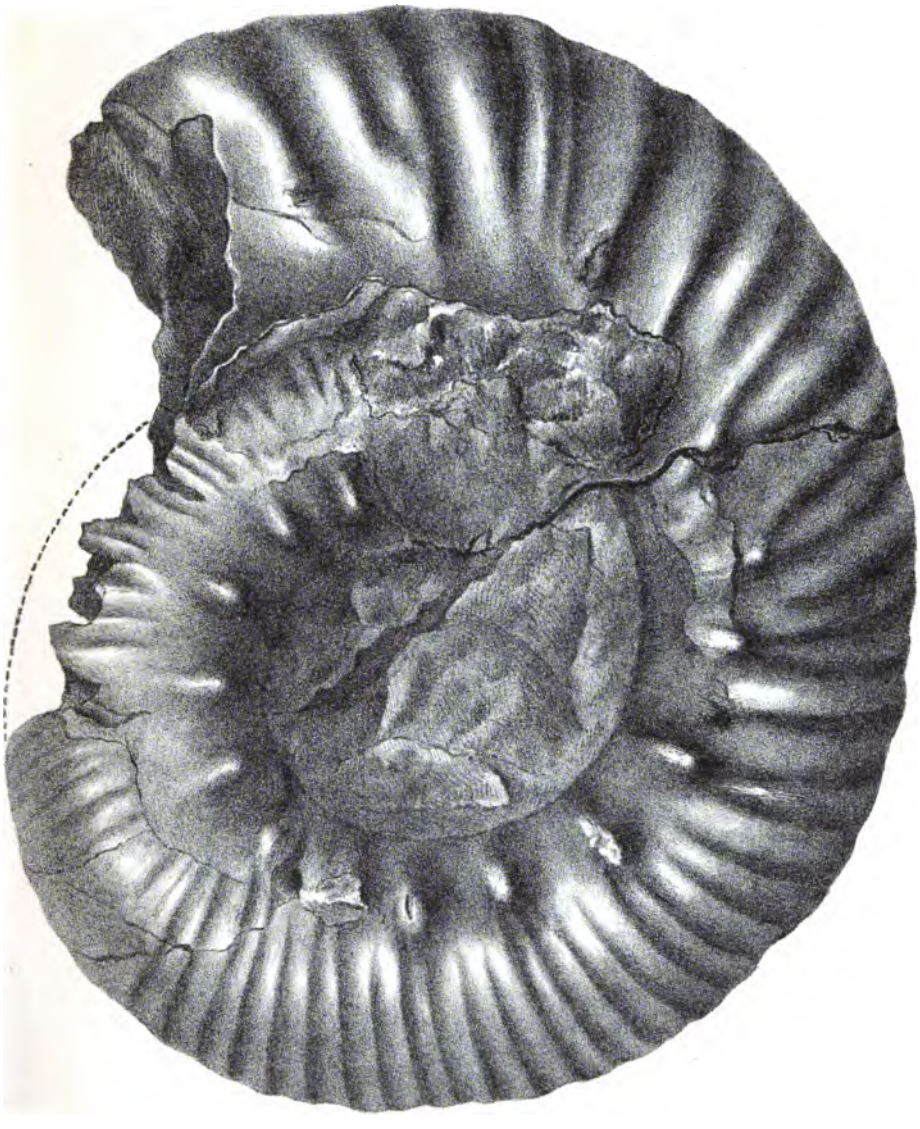
1.a.



## *PLATE VI.*

AMMONITES CARLOTTENSIS (page 38.)

Side view of the type of this species. The shape of the aperture is shown in wood-cut No. 5 on page 38.



A.H.Foord, del et lith
Geo. J. Gebhardt, impt

## *PLATE VII.*

AMMONITES SKIDEGATENSIS (page 34).

**Side view of the largest individual collected. An outline of the aperture of this specimen is given in wood-cut No. 4, on page 34.**

A.H.Foord del et lith

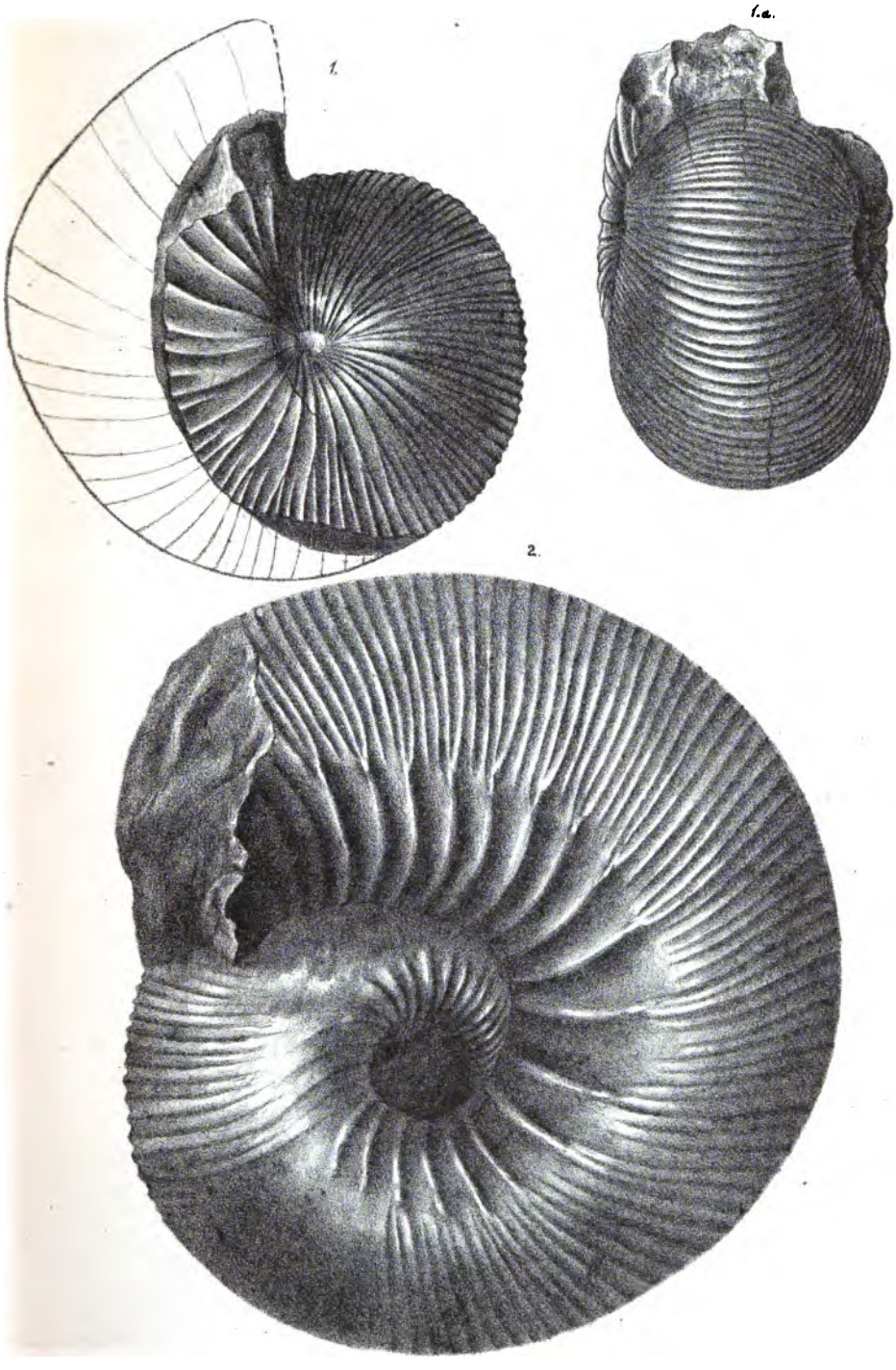
## *PLATE VIII.*

AMMONITES LOGANIANUS. Form B. (page 30.)

Figure 1. Side view, partly restored.
" 1 *a*. Front of the same specimen.

AMMONITES LOGANIANUS. Type. (page 27.)

Figure 2. The most perfect side of a crushed and distorted example of this species. The wood-cut (figure 3, on page 28) showing the outline of the aperture, is drawn from another individual.


1.
1.a.
2.

## *PLATE IX*

AMMONITES SKIDEGATENSIS (page 34.)

1 e 1. A supposed young individual of this species.

AMMONITES CRENOCOSTATUS (page 45.)

Figure 2. Side view.

" 2 *a*. Portion of the test of do. magnified.

HAMITES, Sp. undt. (page 48.)

Figure 3. The only specimen yet obtained.

AMAUROPSIS TENUISTRIATA (page 48.)

Figure 4. Dorsal view of one of the most perfect examples. The two apical whorls are partly restored.

" 4 *a*. Surface markings of the same, magnified.

SCALARIA ALBENSIS (? ?), D'Orb. (page 50.)

Figure 5 A fragment of a shell which is very doubtfully referred to this species. It may not be a *Scalaria* at all.

PLEUROTOMARIA SKIDEGATENSIS (page 51.)

Figure 6. Dorsal aspect.

" 6 *a*. Base of the same to show its sculpture, also the shape and size of the umbilicus.

MARTESIA CARINIFERA (page 54.)

Figure 7. Left valve * of the only specimen, magnified about six times.

PLEUROMYA CARLOTTENSIS (page 57.)

Figure 8. Right valve.

PHOLADOMYA OVULOIDES (page 59.)

Figure 9. Left valve.

CALLISTA SUBTRIGONA (page 63.)

Figure 10. Left valve.

CALLISTA, Sp. undt. (page 64.)

Figure 11. Left valve.

LUCINA, Sp. undt. (page 61.)

Figure 12. A right valve, with the anterior end downwards. See also wood-cut No. 6.

UNIO HUBBARDI, Gabb (page .65)

Figure 13. Right valve of a narrowly elongated variety of this species. The dotted lines are added not by way of restoration, but to show the more usual contour of the posterior end, as seen in other specimens.

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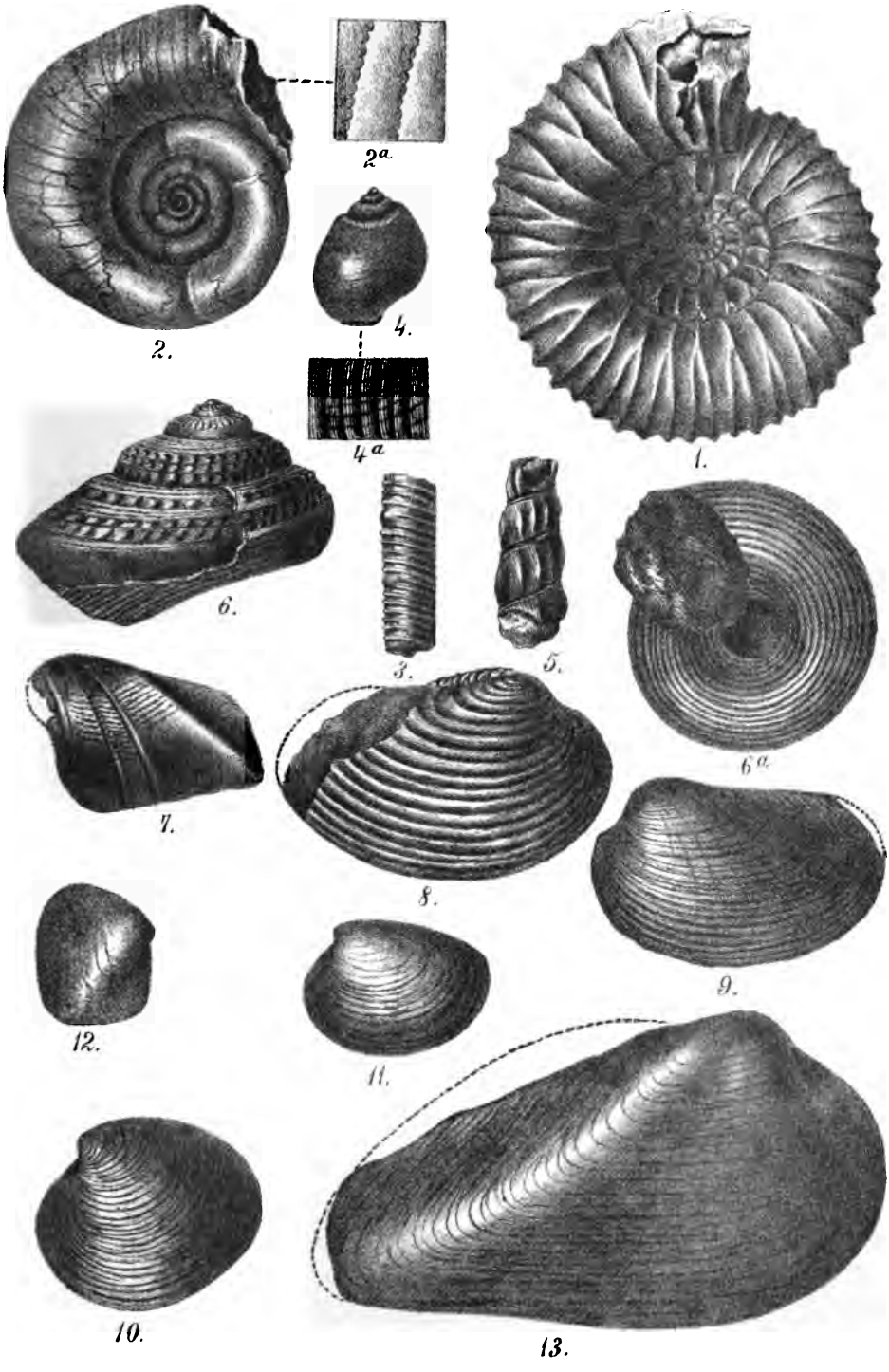
* Most of the lamellibranchiates figured on this and the following Plate have both valves preserved but the best side has been uniformly selected for illustration.


2a
2.
4.
4a
1.
6.
3.
5.
6a
7.
8.
9.
12.
11.
10.
13.

## *PLATE X.*

TRIGONIA DIVERSICOSTATA (page 68)

Figure 1. Left valve of an average example.

TRIGONIA, Sp. undt. (page 70.)

Figure 2. Left valve of an undistorted individual, with a portion of the outer surface of the test preserved. Part of the right valve is also visible.

" 2 *a*. Left valve of a crushed and exfoliated specimen.

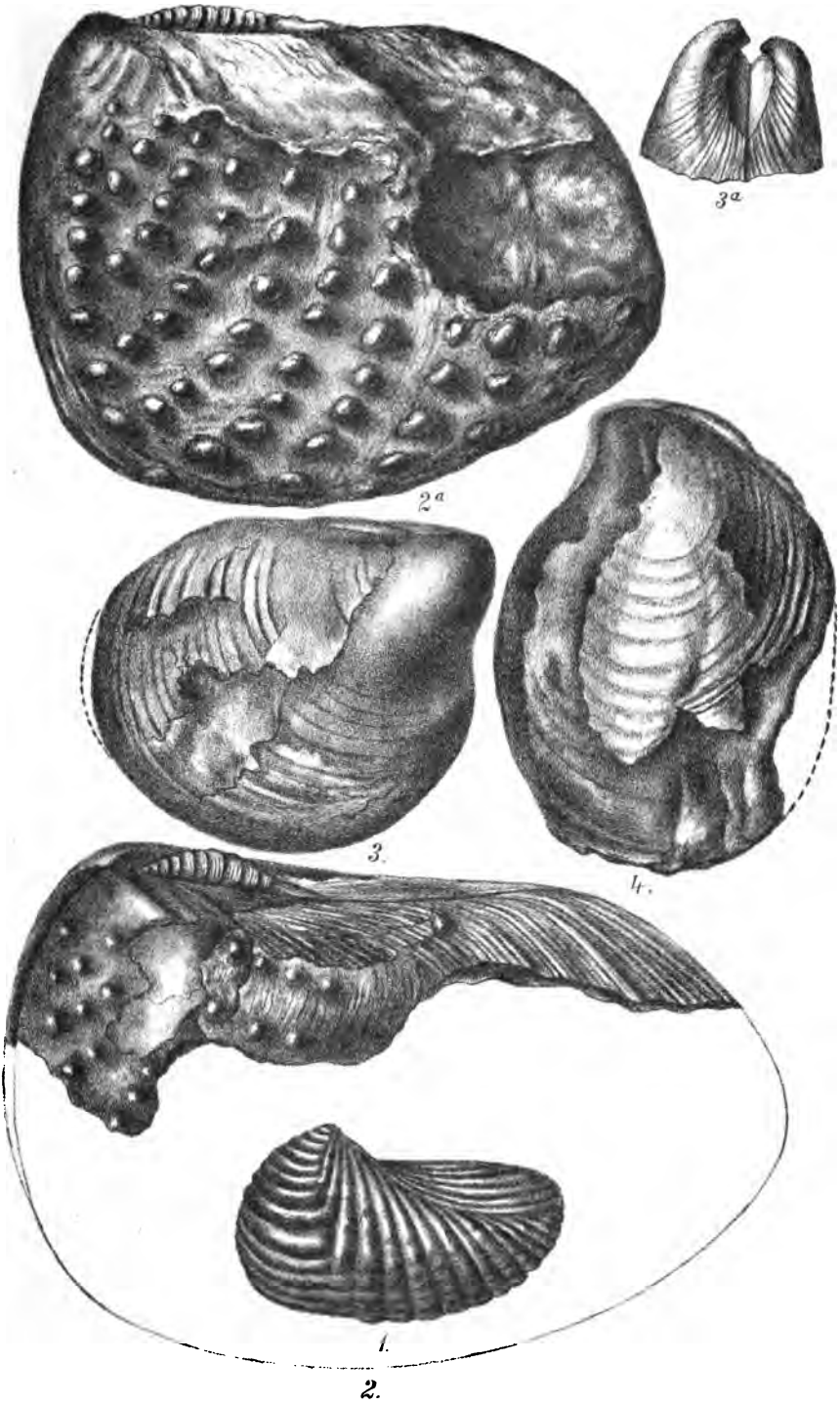
AUCELLA MOSQUENSIS (?) Von. Buch. (page 74.)

Figure 3. Right valve of a distorted example.

" 3 *a*. Portion of the anterior margin above, to show the inflection of both valves just below the beaks.

MELEAGRINA AMYGDALOIDEA (page 78.)

Figure 4. Right valve of the type of the species.


3a
2a
3.
4.
1.
2.

INDEX

F. *Fossils.*

——— *Boundary of Divisions.*

– – – – *Probable continuation of same.*

1. *Lower shales with coal and iron ore.*

2. *Coarse conglomerate.*

3. *Upper shales and sandstones.*

*See Report of Progress for 1872-73 Page 57.*